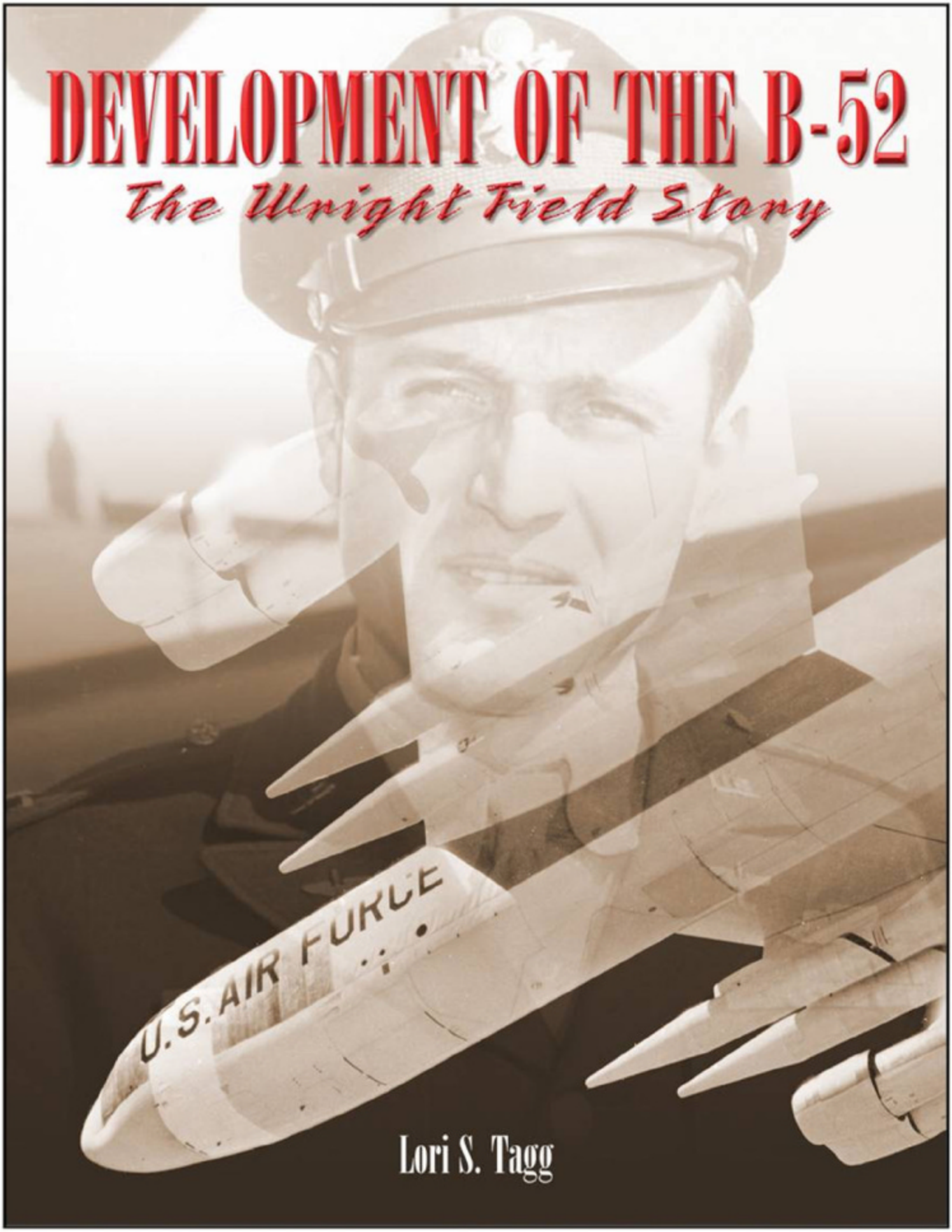
DEVELOPMENT OF THE B-52

The Wright Field Story



Lori S. Tagg

DEVELOPMENT OF THE B-52
THE WRIGHT FIELD STORY

Lori S. Tagg

History Office
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2004

Foreword

The legend of the origin of the B-52, one of the greatest airplanes ever built, is a story so improbable, so unlikely that it could be dismissed as fable were there not evidence to the contrary. The legend portrays the birth of the B-52 as a desperate design exercise by a small team of Boeing engineers one weekend in a hotel room in Dayton, Ohio. As with all enduring legends, the story is essentially correct but greatly simplified. How the engineers got there and who mandated their task has been a more obscure part of the story.

Fortunately, the full account is now available with Lori Tagg's ***Development of the B-52: The Wright Field Story***. Ms. Tagg describes the role of Wright Field and Lieutenant Colonel Henry "Pete" Warden in the post-World War II struggle to acquire a high-speed, intercontinental bomber for the U.S. Air Force. Beginning in 1946, Air Force leadership sought a new bomber for the strategic mission of delivering atomic weapons. No other mission had a higher priority, and the Bombardment Branch at Wright Field awarded a design study contract to the Boeing Airplane Company. Their task was to create an aircraft to replace the B-36, a massive piston-engine bomber that even then was a questionable vehicle for this important mission. The B-36 was slow and vulnerable, but the means to remedy these deficiencies were not at hand.

In this post-war period the combination of jet engines and swept wings offered the possibility of high-speed flight, an obvious benefit for the military. But whether or not this combination was practical for a large bomber remained to be seen. The Boeing design team struggled through 1946, through 1947, and into 1948 with designs based on efficient, but slower, turbo-prop propulsion. Concurrently, Lieutenant Colonel Warden struggled to keep the contract funding in place through countless briefings to Air Force leadership in the Pentagon. Pete Warden was committed to this program, and his cause was aided by engineering experts at Wright Field who advised him on the encouraging progress in jet engine technology. Drawing from this engineering knowledge and his conviction that Boeing could create the bomber the Air Force needed, Warden kept pressing for a high-speed aircraft.

A pivotal event, and central to the B-52 legend, occurred in October 1948. The occasion was a meeting of Boeing team leaders with Lieutenant Colonel Warden. Such meetings had been held before, and Pete Warden and the Boeing engineers were well acquainted with each other. No doubt this personal relationship gave Warden a measure of confidence to direct a dramatic change in his contractor's project. He directed Boeing to abandon their turbo-prop concepts and to initiate a turbo-jet concept employing a new jet engine from the Pratt & Whitney Company. Furthermore, Warden needed this new concept quickly to fortify the program funding, always in jeopardy from naysayers in the Pentagon.

Legends are inspired by desperate situations and extraordinary actions, and this situation was no exception. The Boeing team understood Warden's position and the urgent need for a new design, and they agreed to return to their Dayton hotel room for a hastily improvised design session. There, during an extended three-day weekend, the engineers took a bold step into the future by combining their knowledge of swept-wing aerodynamics with the jet engine. When they returned to Pete Warden's office on Monday morning, they presented a bomber design featuring eight jet engines and looking remarkably like the B-52 prototype that would fly in 1952. It was an airplane that promised to meet the demands of the Strategic Air Command. Most importantly, the radical new configuration enabled Warden to persuade the Pentagon generals to continue program funding.

Throughout this sequence of events, Lieutenant Colonel Warden was the man in the middle. Generals in the Pentagon may order aircraft, may allocate financial resources to have them built. Industrial firms may turn blue prints into hardware. At the heart of this enterprise stood Wright Field and the offices of program managers, including Pete Warden. It was his job to translate what the Strategic Air Command wanted, what the generals ordered, into engineering direction that could motivate the Boeing team to excel. Above all, it was Pete Warden's job to embrace the potential of high risk technology and to demonstrate confidence in the Boeing engineers who were confronted with a radical, new concept—high-speed jet propulsion.

Lieutenant Colonel Warden and the Boeing team succeeded beyond all expectations. The result of their endeavors to invent the future was the B-52, one of the greatest airplanes ever built. But this remarkable outcome might never have happened without Pete Warden's foresight and determination. The events at Wright Field have been indistinct before now, with most of the published history of the B-52 accounting for its production and operational service. Ms. Tagg brings to public view a compelling story of an individual and an institution in an enterprise that shaped the modern Air Force and its future. Lieutenant Colonel Henry Warden represents the best of Wright Field—clear vision, sound engineering knowledge, firm decision making, and persuasive advocacy.

SQUIRE L. BROWN, Ph.D.
Chief, Flight Mechanics Branch (Retired)
Engineering Directorate
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PREFACE

In April 2002, Colonel Ron Thurlow (USAF, Retired, and a frequent volunteer with the ASC History Office) telephoned Ms. Diana Cornelisse (Chief, ASC History Office) to talk about the 50th Anniversary of the first flight of the B-52. I had already expressed interest in doing a monograph on the bomber in honor of this great milestone, so Ms. Cornelisse had Colonel Thurlow talk to me. When he first told me of Colonel Henry Warden (USAF, Retired), who had been Chief of the Bombardment Branch at Wright Field during the development of the B-52, I was immediately intrigued. Through the assistance of Colonels Thurlow and Wayne Pittman (USAF, Retired), I was able to track down Colonel Warden, who graciously agreed to an interview at his home in Columbus, Mississippi.

This book essentially is divided into three parts. The first is an introduction to the long-range bomber issue of the 1940s. Following that, I provide a chronology of the developmental years of the B-52, when it evolved from a straight-wing turboprop airplane to a swept-wing turbojet bomber. The final part is a brief overview of the B-52 bomber's operational usage over the past 50 years. A second volume is planned for the discussion of the weapons and modifications that have provided the B-52 with its awesome capability over the last half century.

My interview with Colonel Warden forms the backbone of this book. I have supported it with numerous quotations from documents of the period to give the reader a taste of the interaction between the interested parties—Air Staff, Air Materiel Command, Boeing and other airplane manufacturers, engine manufacturers, and the laboratories at Wright Field. Obviously, not every detail of the development could be covered. I have chosen to focus on the changes to the airframe and engine during the first five years of the B-52's history. It is also important to note that I worked with existing documents from the ASC History Office Archive. I (and the reviewers) developed numerous questions that, unfortunately, could not be answered from the available documentation. I am interested in hearing from individuals who might shed light on some of those incomplete details.

A number of individuals provided assistance during the production of this book. I would like to thank Colonel Thurlow for suggesting an interview with Colonel Warden, and Ms. Cornelisse for allowing me to pursue the project at my own pace. Colonel Thurlow, Colonel Pittman, MSGT Dave Menard (USAF, Retired), Dr. Squire Brown (retired engineer from the Aeronautical Systems Center's Engineering Directorate), Dr. James Aldridge (ASC History Office), Mr. George Cully (AFMC History Office), and Mr. Martyn Tagg (AFMC Cultural Resource Manager) read the draft and offered numerous editorial suggestions. Dr. Mark Mandeles (President of The J. De Bloche Group) provided copies of his notes from his interview with Colonel Warden in 1984. Photographs were obtained through the assistance of Colonel Pittman, Mr. Brett Stolle (United States Air Force Museum), Mr. Jack Connors (Pratt & Whitney Archives), Mr. Tom Lubbesmeyer (Boeing Archives), and Dr. Paul Ferguson (AFMC History Office). The security review was conducted by Mr. Bill Meers (ASC Public Affairs) and Mr. Archie Difanti (Air Force Historical Research Agency, Maxwell Air Force Base). Mr. Curtis Alley (National Air and Space Intelligence Agency) designed the cover. A special thank you to Dr. Brown for agreeing to write the Foreword for this book.

Colonel Henry Warden was particularly generous with his time for in-person interviews and many telephone conversations. He also provided photographs and access to his interview with Hugh Ahman. I would also like to thank his wife, Joanna, for her hospitality and a wonderful lunch during my visit. Finally, Art Boykin also took the time to answer my numerous questions. Of course, any misinterpretations or misrepresentations of the facts are solely the responsibility of the author.

This book is dedicated to Colonel Henry Warden and his staff in the Bombardment Branch during the development of the B-52.

LORI S. TAGG
Historian
March 2004

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Six Smart Guys, an Airplane, and a Hotel Room

On October 21, 1948, Boeing officials arrived at Wright Field to discuss the turboprop model of the XB-52 bomber with Lieutenant Colonel Henry E. "Pete" Warden, Chief of the Bombardment Branch in the Engineering Division. At the time, the XB-52 was under intense criticism for not being enough of an improvement over the Convair B-36 to warrant further development. A threat of cancellation, not the first and not the last, hung in the air. Colonel Warden requested that the Boeing representatives conduct a preliminary study on an XB-52 model powered by Pratt & Whitney J57 turbojet engines. As the popular version goes:

> "The Boeing engineers went back to the Van Cleve hotel and in classic 'back of the envelope' style began synthesizing the years of effort that had accumulated on all of their diverse programmes into one. On Friday morning they called Warden and told him they would have a proposal on the following Monday….
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> "These six men distilled their wisdom into an entirely new aircraft design. …They created a 33 page proposal for a large aircraft. …Called the Boeing Model 464-49-0, it had a design gross weight of 330,000 pounds, a high speed of 572 mph and a range of 8,000 miles with a 10,000 pound bomb load.
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> "On Monday morning the team presented Warden with the slim proposal…which included an inboard profile, three-view drawing, drag polars and weight estimates.
>
> "[Edward C.] Wells, [Boeing's Vice President of Engineering,] already a world famous engineer with extraordinary status in the aviation community, not only did the three-view drawings, but assisted [George] Schairer [Chief of Aerodynamics] with the construction of a balsa model of the proposed aircraft, which, painted silver, was put on a stand and presented to Warden to take…to the Pentagon.
>
> "Warden was ecstatic with the proposal despite the fact that it combined a new airframe with new engines and a new technique of inflight refueling. Acting on his own authority, confident that he would receive backing from his superiors, he authorized Boeing to terminate their efforts on the

Edward Wells, Vice President of Engineering, and George Schairer, Chief of Aerodynamics, were two of the six Boeing representatives in the Van Cleve Hotel over the fateful weekend in October 1948. (*United States Air Force Museum, Orville Long Collection*)

turboprop projects, and promised to deliver new funding for the XB-52 within a few months. And he did."[1]

And so the XB-52 design, looking very much like the actual airplane that first rolled out of the factory in November 1951, was born.

As Colonel Warden stated 50 years later, the story was more detailed than is popularly known. The Boeing engineers mentioned the long series of developmental roads that led to that single design. H. W. "Bob" Withington, one of the Boeing men in that hotel in October 1948, stated in 2002, "The books that have been written about Boeing have universally gotten that story wrong. …All the books tried to popularize it like (we) invented an airplane on a weekend, and that simply is not true. …It wasn't an accident. There was a lot of good data behind it."[2]

There was also a lot of Air Force influence in that airplane. Colonel Warden recalled half a century after the XB-52's first flight:

> "The perception is that you get three or four smart guys that go in there and design an airplane over the weekend, bring it in there, and you're off and running. And nobody does that. …There's a great tendency for people to talk about Boeing airplanes, not Air Force-Boeing airplanes."[3]

Artist's conception of the XB-52 bomber with eight turbojet engines. The XB-52 progressed through numerous changes before reaching the jet configuration.

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[1] Walter Boyne, *Boeing B-52: A Documentary History* (London: Jane's Publishing Company Limited, 1981), pp. 50-52; *cf*. Harold Mansfield, *Vision: A Saga of the Sky* [2nd Edition] (New York: Madison Pub. Associates, 1986).

[2] John Andrew Prime, "Bomber has roots in aviation legend and myth," *Shreveport Times*, 14 Apr 2002, viewed online 12 Dec 2002 at http://www.shreveporttimes.com/html.

[3] Interview with Col Henry Warden, by Lori S. Tagg, 20 Jul 2002, Columbus, Mississippi. Tapes and transcript on file at ASC/HO.

Early Long-Range Bomber Development

Brigadier General William "Billy" Mitchell stated, during World War I, "no one can ever tell me that there is nothing in airplane bombing. It will have a great effect on all the operations, if efficiently carried out."[4] Bombing operations in World War I did not reach the level envisioned by Mitchell and, in fact, it was not until 1920 that the United States mass-produced its first airplane specifically for the bombing mission—the Martin MB-2/NBS-1. At this time, however, the bomber's primary role was reconnaissance and development of a heavy bomber lagged behind other airplane types due to a lack of funds. By the middle of the decade, other Air Service officials, such as Major General Benjamin D. Foulois, who became Chief of the Air Corps[5] in December 1931, began to support the development of long-range bombardment doctrine and equipment.[6] They joined voices with Mitchell in pushing for modern weapons of airpower, particularly for bombardment, and an independent air arm co-equal with the U.S. Army and U.S. Navy.

General William "Billy" Mitchell (*NCR Archives, Montgomery County Historical Society*)

By the early 1930s, the heavy bomber received critical backing from many high-level military officials, not the least of whom was Army Chief of Staff General Douglas MacArthur.[7] Bomber development accelerated throughout the 1930s, with the Air Corps' procurement of the Boeing B-9, Martin B-10, Boeing XB-15, and the Douglas XB-19. These airplanes, among others, provided the evolutionary steps to what would become the long-range bombers of World War II: the Boeing B-17 Flying Fortress, Consolidated B-24 Liberator, and Boeing B-29 Superfortress.

Benjamin D. Foulois

Built upon lessons learned in the XB-15 program, the B-29 Very Long Range Bomber program was launched in 1940 under the capable leadership of Captain Donald L. Putt.[8] As the United States watched the German army overrun Europe, fears that overseas bases would not be

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[4] Quoted in Mary R. Self, *History of the Development and Production of USAF Heavy Bombardment Aircraft, 1917-1949* (WPAFB: Historical Office, Dec 1950), pp. 2-3. Mitchell's advocacy of strategic air power brought him into conflict with numerous high officials, resulting in his 1925 court-martial for insubordination. He was Assistant Chief of the Air Service when he was court-martialed. Mitchell was posthumously awarded a special Medal of Honor in recognition of his foresight.

[5] The Air Service became the Air Corps on July 2, 1926.

[6] Robert F. Futrell, *Ideas, Concepts, Doctrine: Basic Thinking in the United States Air Force*, *Volume 1: 1907-1960* (Maxwell Air Force Base: Air University Press, 1989), p. 66. In 1910, Benjamin D. Foulois was the Army's only active pilot. By 1931, General Foulois had become Chief of the Air Corps. Despite their mutual animosity, Foulois and Mitchell pushed for an independent air force and advocated long-range strategic bombing.

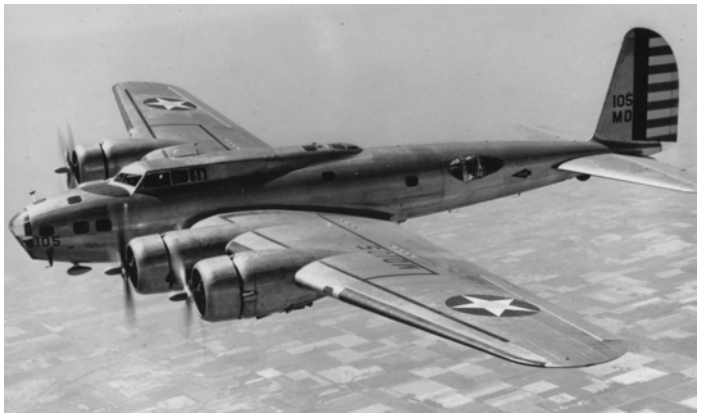
[7] Self, *Heavy Bombardment Aircraft*, p. 16. Notably, MacArthur gave the one dissenting vote in the court martial of General Mitchell for his outspoken views on the potential of airpower.

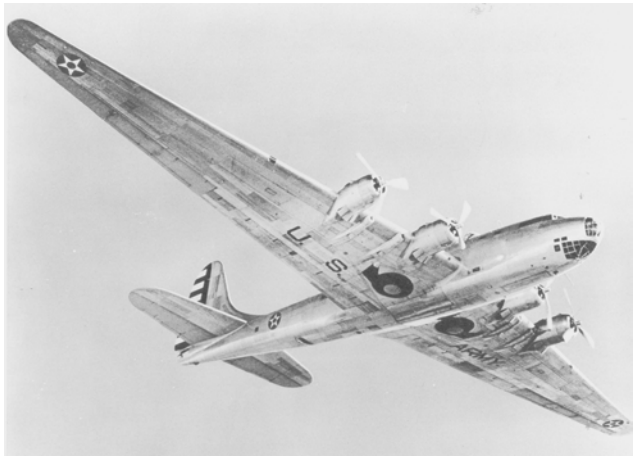
[8] Donald L. Putt (1905-1988) began his career at Wright Field in 1933 as a test pilot in the Flying Branch of the Materiel Division. He was assigned to the Production Engineering Section in 1939, and eventually became Chief of the Bombardment Branch. In December 1944, Putt left for duty in Europe and, upon returning the following year, he was the Assistant Chief of Staff/Intelligence at Air Technical Service Command headquarters. In 1946, he served as Chief of the Engineering Division. After duty in the Office of the Chief of Staff of Development, Putt was named Vice Commander of Air Research and Development Command (ARDC) and concurrently the Commander of Wright Air Development Center. He became ARDC Commander in 1953. Donald L. Putt Biography File, ASC/HO.

The Martin MB-2 first flew on September 3, 1920. Only the first five were built as MB-2s; the remaining 125 were built as NBS-1s. General Mitchell chose the MB-2 (NBS-1) for his demonstration of aerial bombardment in 1921. The bombers successfully bombed a destroyer, a cruiser, and a battleship.

The Martin B-10 bomber was developed in the early 1930s. With a 70-foot wingspan and powered by two Wright Cyclone engines, the bomber achieved a top speed of 207 mph.

Ten of Boeing's B-17 Flying Fortresses arrived at Wright Field for testing in 1937. By the time production ended in 1944, more than 12,500 B-17s had been manufactured.





When begun as Project D in 1935, the Douglas XB-19 was called the "ultra-long range bomber." The XB-19 had a 212-foot wingspan, 132-foot length, and a gross weight of 140,000 pounds. The large bomber first flew in 1941, but because of its low top speed, it was not produced in quantity.

available for the Army's short-range aircraft fueled the drive for longer reaching planes. Putt's initial requirements for the B-29 included a 4,000-mile range (approximately 1,500 miles radius), which the experimental version of the bomber surpassed. In 1944, B-29s with the 20th Air Force entered the war in the Pacific theater and, the following year, two B-29s (the *Enola Gay* and *Bock's Car*) carried the atomic bombs dropped on Hiroshima and Nagasaki, Japan. By mid-1946, more than 3,900 B-29s had been manufactured, and they went on to serve in the Korean War before being phased out beginning in the early 1950s.[9]

Developed in 1940, Boeing's B-29 Superfortress was slated to replace the B-17 and B-24. After its first flight in 1943, production B-29s were sent to the Pacific theater during World War II. The bomber had a top speed of 350 mph and a range of 3,700 miles.

Development of the intercontinental B-36 bomber also began before United States' entry into World War II. The Army Air Forces (AAF) started development of the Convair B-36 (popularly known as the Peacemaker) on November 15, 1941, when Convair[10] was given an order for two XB-36s. With a heavy production program already in place for the B-24, Convair was not able to begin serious effort on the big bomber until 1943, when a production decision was made. In the postwar period, development continued on the 276,000-pound bomber, which was estimated to have a range of nearly 10,000 miles (about 3,750 miles radius). When the XB-36 first flew in 1946, it was underpowered. Even a number of engine upgrades, including the mounting of auxiliary jets under the wings, failed to increase its speed to a rate at which the protection of escorts was not needed. This, among other factors, was the impetus to develop a new heavy bomber in the postwar period. Although it never dropped a bomb in combat, the B-36 proved to be a powerful deterrent to atomic war with the Soviet Union in the early Cold War.[11] The B-52, which Air Force Chief of Staff General Nathan F. Twining called America's "long rifle" at the rollout of the first B-52A,[12] would continue that role, as well as take on new missions, throughout the second half of the twentieth century.

The Convair B-36 "Peacemaker" dwarfed the B-29 in size and bomb capacity. More importantly, the B-36's range was nearly double that of the service's previous long-range bomber.

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[9] Marcelle Size Knaack, *Encyclopedia of U.S. Air Force Aircraft and Missile Systems, Volume II: Post-World War II Bombers, 1945-1973* (Washington, D.C.: Office of Air Force History, 1988), pp. 485, 493; Ray Wagner, *American Combat Planes* [2nd Edition] (New York: Doubleday & Company, Inc., 1968), pp. 134-136.

[10] Consolidated Aircraft and Vultee Aircraft corporations merged in 1943 and soon became known as Convair.

[11] Knaack, pp. 3-4; Wagner, pp. 140-141.

[12] General Nathan F. Twining, Chief of Staff of the U.S. Air Force, stated at the rollout of first B-52A, "To say that this is the greatest bomber in the world today is putting it very, very mildly. …And the progress that this airplane has made since the prototype was put on the line is something that has never been equaled. …The long rifle was the great weapon of its day. …Today this B-52 is the long rifle of the air age." News Release, No. S-2937, Boeing, Subj: B-52 Termed "Long Rifle," quoted in Kenneth L. Patchin and James N. Eastman, *The B-52 Stratofortress, Volume I: B-52 Management* (Tinker Air Force Base: OCAMA, 1961), p. iii.

Wright Field underwent extensive expansion during the war. From 40 buildings in 1941, the installation had more than 300 by early 1944, as shown in this aerial view.

The Postwar Research and Development Program

The majority of AAF in-house research and development during World War II occurred at Wright Field in Dayton, Ohio. At that time, the Air Technical Service Command (ATSC), led by Lieutenant General William S. Knudsen, had its headquarters on Wright Field.[13] The Chief of Engineering and Procurement, Major General Kenneth B. Wolfe, oversaw the activities of the Engineering, Procurement, and Readjustment divisions and the Flight Section.[14] By the end of the war, a number of organizational changes had taken place. Knudsen was replaced by Major General Hugh J. Knerr and the Engineering and Procurement divisions were replaced by T-3 Engineering, led by Major General Benjamin W. Chidlaw, and T-4 Supply, overseen by Major General Lester T. Miller (see Appendix 1, Chart 1). The Engineering Division, under the leadership of Brigadier General Laurence C. Craigie, was placed within T-3 Engineering (see Appendix 1, Chart 2). It included the Service Engineering Subdivision, a part of which was the Aircraft Projects Section responsible for new airplane developments. Laboratories were divided up among the Aircraft and Physical Requirements Subdivision (Aircraft, Aero Medical, Materials, and Personal Equipment laboratories), Propulsion and Accessories Subdivision (Armament, Equipment, Photo, Power Plant, and Propeller

[13] The headquarters of the Air Technical Service Command (ATSC) originally was located at Patterson Field. When Air Serveice Command and Air Materiel Command merged in 1944, the acting commander of Air Service Command incorporated the part of Patterson Field occupied by headquarters into Wright Field. The headquarters portion of Wright Field then became known as Area A and the original Wright Field was known as Area B. The remainder of Patterson Field became Area C when it merged with Wright Field in 1948.

[14] ATSC, Organizational Charts, 1 Jan 1945 and 17 Oct 1945, on file at ASC/HO.

laboratories), and the Electronic Subdivision (Communications and Navigation, Special Projects, Systems Engineering, Engineering Services, and Radar laboratories).

Within the Aircraft Projects Section, led by Colonel Benjamin S. Kelsey, were individual branches for aircraft type: Bombardment, Rotary Wing, Fighter, Cargo, and Pilotless, as well as an Equipment Branch and a Flight Data Branch (see Appendix 1, Chart 3). Their offices were located on the second floor of Building 126. In late 1945, the Chief of the Bombardment Branch was Lieutenant Colonel Pete Warden.[15]

Warden joined the Bombardment Branch in the summer of 1944. He had just returned from duty with the 20th Pursuit Squadron (Interceptor), with which he had served as a depot inspector at Nichols Field in the Philippines, until the withdrawal to Bataan in December 1941. Warden had been sent south to find more aircraft for the defense of the Pacific islands, and he narrowly missed the surrender of U.S. and Philippine forces to the Japanese in April 1942. He then flew to Australia where he served in the air logistics system before finally returning to the states. Warden requested duty at Wright Field because "it was the engineering center of the Air Force."[16] Warden's background included a bachelor's degree in aeronautical engineering from Catholic University in Washington, D.C. (1936), and he was close to completing his master's degree at the Massachusetts Institute of Technology (MIT) when he joined the Army Air Forces as a lieutenant in November 1939.

In late 1945, Lieutenant Colonel Henry E. "Pete" Warden (left) and Captain Glen Edwards piloted the XB-42 on a record-setting transcontinental flight. With an average speed of 433 mph, they made the cross-country trip in 5 hours 17 minutes. Edwards later died in the crash of the YB-49. (*Lt Col Henry E. Warden, USAF, retired*)

Upon arriving at Wright Field, Warden was placed in charge of the XB-35 and XB-36 programs in the Bombardment Branch.[17] A year later, in May 1945, he became Chief of the Bombardment Branch.[18] Assisting Warden was his civilian deputy, J. Arthur "Art" Boykin, a South Carolina native who joined the Engineering Division in 1940 to work on foreign development projects. He had previously served as Warden's civilian counterpart in the B-36 program before becoming Deputy Chief of the Bombardment Branch in 1945.[19]

Warden's and Boykin's first task was to determine the objectives of the postwar research and development program for bombardment aircraft. Boykin stated in an August 1949 presentation:

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[15] Aircraft Projects Section, Engineering Division, ATSC, Organizational Chart, 1 Oct 1945, on file at ASC/HO.

[16] Warden, Interview with Lori Tagg.

[17] At this time, the Bombardment Branch was divided into two units: the Heavy Bombardment Unit and the Light and Medium Bombardment Unit. Warden's project office in the Heavy Unit meant his immediate supervisor was Colonel Donald L. Putt, Chief of the Heavy Unit and the Bombardment Branch as a whole. Chief of the Light and Medium Bombardment Unit was Colonel Victor R. Haugen. Organizational Chart, Engineering Division, 19 Oct 1944, on file at ASC/HO.

[18] Colonel Putt left for duty overseas in December 1944 and was replaced by Colonel Frank R. Cook. Cook's primary involvement was with the B-32 program, and he was appointed commander of the combat test detachment for three B-32s sent to the Pacific theater in May 1945. "Consolidated B-32 Dominator," from Stephen Harding, "Flying Terminated Inventory," *Wings*, Apr 1993, p. 40, viewed online 9 Dec 2002 at http://home.att.net/~jbaugher2/b32.html; also see Stephen Harding and James I. Long, *Dominator: The Story of the Consolidated B-32 Bomber* (Charleston: Pictorial Histories Publishing Co., Inc., 1984).

[19] J. Arthur Boykin, Biographical File, ASC/HO; Telephone Interview with J. Arthur Boykin by Lori S. Tagg, 15 Jan 2003, notes on file at ASC/HO.

> "Our long term objective is the all weather bomb delivery to any target up to and including global coverage from operating bases within the continental limits of the United States. After consideration of potential operating bases and analysis of selected target complexes, the operating radius required to effect this coverage is 4300 nautical miles [approximately 4,900 statute miles]."[20]

Boykin further explained that during the war, the AAF had no fewer than nine bombardment aircraft to cover target systems up to a 1,800-nautical-mile [2,000-statute-mile] radius. These included the B-17, B-18, B-24, B-25, B-26, B-29, and B-32, all of which saw service in the war, in addition to the A-20, A-26, and other attack aircraft. With declining budgets following the war, however, the AAF was forced to cut back on experimental development. Consequently, Warden and Boykin planned, on a large sketchpad they kept in their office, a three-bomber concept to fulfill the long-term objective.[21] The concept included a light, medium, and heavy bomber. Warden pointed out that this nomenclature was based on mission requirements and

> "…does not necessarily bear any relationship to the same nomenclature used previously. For example, the medium bomber, in this concept, will carry twice the bomb load at over more than 2½ times the cruising speed and 2½ times the range as the heavy bomber of World War II."[22]

While Boykin suggested that, in retrospect, the previous practice of producing more than one aircraft for a single mission might have been of questionable value, the three-bomber concept provided a limited opportunity to produce a successful airplane. Warden believed that

> "…this dictates that every experimental bomber must in reality be a potential production article or else the time delay in supplying tactical units with improved weapons could be disastrous. Likewise, each project must be sufficiently advanced in its concept so as to prevent its early obsolescence and yet at the same time we must carefully refrain from adopting any radical design for development which involves more than a soundly calculated risk of being successfully developed in the given time period."[23]

These observations proved true throughout the development of heavy bomber aircraft in the immediate postwar period.

The light bomber envisioned by the Bombardment Branch was primarily a ground support aircraft of high speed, high maneuverability, and short range (around 460 statute miles/400 nautical miles radius).[24] This new bomber was planned as a replacement of the B-26 and B-45, the latter being the Air Force's first jet-propelled bomber scheduled for production. In 1945, industry's response to the military characteristics for a bomber of this type led to development of Martin's B-51, an airplane powered

James Arthur "Art" Boykin, Deputy Chief of the Bombardment Branch at Wright Field during the development of the B-52. Boykin began his career at Wright Field in 1940 and retired in 1975 with 35 years of service at Wright-Patterson Air Force Base.

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[20] J. Arthur Boykin, Presentation: "Trends and Objectives for Bombardment Aircraft Development," 8 Aug 1949, p. 1, in Box 3054: Aircraft/Bomber, Box 1: Development, ASC/HO Archive.
[21] Boykin, Telephone Interview with Lori Tagg.
[22] Lt Col H. E. Warden, Presentation: "Light, Medium, Heavy Bombardment Objective," given 28 Feb 1949 to Air Command and Staff School, Maxwell Air Force Base, Montgomery, Alabama, in Box 3054: Aircraft/Bomber Box 1, Development, ASC/HO Archive. Warden's and Boykin's presentations (see note 20) contain much the same information.
[23] Warden, Presentation, 28 Feb 1949, p. 10.
[24] Boykin, Presentation, 8 Aug 1949, p. 1.

by two turboprop and two turbojet engines with a maximum speed of 505 mph, an 800-mile combat radius, and the capability for high-altitude bombing. Indicative of its ground support role, the B-51 was originally called the XA-45. Warden convinced Pentagon officials, particularly Major General Curtis LeMay, at that time Deputy Chief of Air Staff for Research and Development,[25] that close support from 35,000 feet was not practical. Consequently, characteristics were changed in early 1947 and Martin offered a design for a low-altitude aircraft that was powered by three J47 jet engines, carried 4,000 pounds of bombs, and had a top speed of approximately 600 mph.[26] Warden called it "one of the best airplanes that the Air Force never built."[27] The XB-51 made its first flight in October 1949 as the Air Force's first high-speed, jet-propelled, ground support bomber. The program was cancelled in November 1951, after losing a competition against the British-built B-57 Canberra.

Two prototypes of the Martin B-51 light bomber powered by three turbojet engines, one of which was mounted internally. The B-51 program began in 1945 as the XA-45 attack aircraft. The first XB-51 made its maiden flight in October 1949 and the second in April 1950. The program was cancelled in November 1951.

Warden considered the planned medium bomber to be the "workhorse" of the Air Force. For all-weather, high-speed, high-altitude delivery of up to 10,000 pounds of bombs, the Air Force wanted an aircraft with a radius of 2,300 statute miles.[28] It would replace the in-service B-29 and the B-50 models planned for production. As it evolved, the Boeing B-47 Stratojet, the design of which was initiated prior to the three-bomber concept, became the medium bomber. The B-47 program began in late 1944 when Boeing won a design competition for its Model 432, a straight-wing aircraft like the B-29 but with thinner wings and four General Electric axial-flow jet engines mounted in the fuselage. Warden remembered it as "one of the worst airplane designs I've ever seen."[29] Because Boeing was tied up with production of the B-29 while the war still raged in the Pacific, development of the B-47 remained stagnant for a year. When Warden rejected the original design as unsafe due to the location of the engines, Boeing responded with a design for its first swept-wing aircraft powered by six turbojet engines, which

The B-47 program began in 1944. Like the B-52, the B-47 began with a straight wing, but Boeing modified it to a swept-wing bomber with six engines. After its first flight in December 1947, a production decision was reached in September 1948. By 1957, the Air Force had accepted 2,041 B-47s.

[25] The Deputy Chief of Air Staff for Research and Development was established in late 1945 as the reporting agency for Project RAND. Curtis LeMay served as the first and only appointee to the post. The position was eliminated in the summer of 1947, and LeMay took over command of the U.S. Air Forces in Europe. RAND, "50 Years of Service to the Nation," viewed online 19 Feb 2003 at http://www.rand.org/history/; Martin J. Collins, *Cold War Laboratory: RAND, the Air Force, and the American State, 1945-1950* (Washington, D.C.: Smithsonian Institution Press, 2002), p. 173; Gen Curtis E. LeMay, U.S. Air Force Biography, viewed online 2 Jan 2004 at http://www.af.mil/bios/bio_6178.shtml.

[26] Warden, Interview with Lori Tagg; Knaack, pp. 546-547.

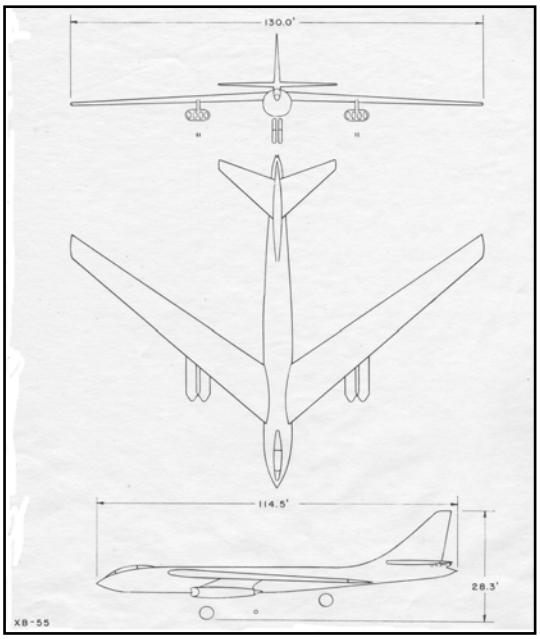
[27] Warden, Interview with Lori Tagg. Warden was particularly impressed with Martin's design for a revolving bomb bay door that could be pre-loaded for quick rearmament. The door rotated 180 degrees and prevented excessive drag from air entering the bomb bay during a bomb run. It was later used on the B-57 Canberra.

[28] Warden, Presentation, 28 Feb 1949, p. 2.

[29] Warden, Interview with Lori Tagg.

eventually came to be located in pods under the wings. The XB-47 made its first flight in December 1947, and a production decision was reached in September of the following year.[30]

Despite the estimated potential of the B-47, the Bombardment Branch almost immediately began considering a replacement for it, stating, "the B-47…will be an exceptionally useful weapon until such time as a replacement can be made in this field."[31] In fact, only two months before the XB-47's first flight, the Bombardment Branch started the XB-55 program as a replacement for the medium bomber. Boeing also submitted the winning design for this competition held in October 1947. Their design was an enlarged B-47 powered by four Allison T40 turboprop engines with a goal of increasing the cruising and top speeds and the operating altitude of the bomber. Over the next few years, the XB-55 program evolved into a paper study on a turbojet delta-wing configuration, but was cancelled in 1949 due to a shortage of funds.[32] By this time, production of the B-47B, with accommodations to carry a nuclear bomb, had been initiated. Consequently, despite early plans to replace it, the B-47 served as the "workhorse" medium bomber of the Air Force until the mid-1960s.[33]



Three-view diagram of the XB-55 design with four turbojet engines. The program was cancelled in 1949.

Warden believed that "[f]rom an Air Force standpoint, the most important of the three airplanes is the heavy [bomber], whose mission will be the delivery of the special bomb load to the strategic target system."[34] The heavy or strategic bomber was envisioned as having an optimum radius of 5,000 statute miles. As previously stated, the need for an intercontinental bomber in 1941 had led to development of the XB-36, but by the mid-1940s AAF officials realized that technical advances would make it obsolete sooner rather than later and that it might not be able to perform the desired mission radius. As the XB-36 got closer to its first flight, the estimated speed of the big bomber drew increasing criticism as it became obvious that the B-36 would always require escort fighters for protection in enemy airspace. Thus begins the history of the development of the XB-52, the third leg of the three-bomber concept as envisioned by Warden and Boykin in 1945.

Organizational Interaction

Provided below is a chronology of the development of the XB-52 from concept formulation to first flight. To put this into context, however, it is necessary to illuminate perhaps one of the most interesting threads running through the XB-52 story—the interplay between the Pentagon, the Bombardment Branch at Wright Field, and Boeing (see Appendix 1, Chart 4). The roles played by each of these organizational entities, although ostensibly all acting with the same goal of "provid[ing] the maximum tactical probability of delivering the Atomic Bomb to [the] strategic target system,"[35] resulted in the B-52 being threatened with cancellation several times throughout its early development.

In the postwar period, the military characteristics for new aircraft developments began in the Requirements Division of the Assistant Chief of Air Staff for Operations and Training (AC/AS-3) in the

[30] Knaack, pp. 102, 105, 107.
[31] Warden, Presentation, 28 Feb 1949, p. 9.
[32] *Ibid*., pp. 6-7.
[33] Knaack, pp. 114, 144.
[34] Warden, Presentation, 28 Feb 1949, pp. 2-3.
[35] *Ibid*., p. 3.

Pentagon. These characteristics were developed in collaboration with the using command and focused on the performance *tactically desired* from a particular aircraft type. The characteristics were then sent to the Engineering Division, Air Technical Service Command (later Air Materiel Command [AMC]), at Wright Field, where project engineers and laboratory personnel determined if the performance was *technically feasible*, given the state of the art. The resulting formalized military characteristics were then issued to industry for design competition. The various offices of the Aircraft Projects Section in the Engineering Division managed the aircraft programs through their development phases. Once a production decision for a particular aircraft was made by the Pentagon, management of that program transferred to the Procurement Division within AMC, which was on an equal footing with the Engineering Division. The Engineering Division continued to maintain a relationship with the program, particularly in light of engineering problems that surfaced as the airplane entered operational service.[36] This method of management was retained until 1950, when Air Research and Development Command and the Wright Air Development Center were created.

During the development phase of an airplane (in this case the XB-52), the Bombardment Branch in the Engineering Division was in continuous contact with several Air Staff offices, including AC/AS-3 (later the Deputy Chief of Staff [DCS] for Operations); AC/AS-4 (Materiel, Maintenance, and Distribution; later DCS for Materiel), particularly the Research and Engineering Division (later the Directorate of Research and Development); and the Deputy Chief of Staff for Research and Development (eliminated in mid-1947). The relationship between the Engineering Division and Air Staff was sometimes adversarial. While many of the individuals who held positions in the Pentagon had, at one time or another, worked at Wright Field, they did not always have the technical background to make the most informed decisions based on the current state of the art. Uncertainty over the projected performance of given technological developments to meet perceived operational needs led to many disagreements over the "proper balance between what is tactically desired and [what is] technically feasible."[37] As Colonel Warden reflected, the XB-52 was a prime example of the problems inherent in finding this balance, particularly with regard to the range requirement:

> "[Air Staff] represented what they wanted; I represented what we could get. And I spent a lot of effort and money learning what we could get, like the generalized bomber studies that we made. …We started that with Convair [to find out] what the trade-offs were [between weight, range, speed, altitude, etc.]. Again, at my level, we were looking at what was possible, not what we would like to have."[38]

Throughout the development of the B-52, officials of the Bombardment Branch traveled to the Pentagon numerous times to present Air Staff with a briefing on why the B-52 program should be continued over any number of competitors or challenges. In the process, they put their careers on the line:

> "In pushing for the B-52—and we had to push, over and over again—there is always something you have to push against. And the 'somethings' do not like it when their views are unaccepted. You would be hard pressed to find somebody today that back then was in favor of the B-52."[39]

Art Boykin also recollected 50 years later, "You could count on the fingers of two hands the people who were behind it."[40]

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[36] Engineering Division, ATSC, *Postwar Research and Development Program of the Army Air Forces, Air Technical Service Command, Project B-7* (Revised)," 25 Jun 1945, pp. 21, 28, in Box 2022: Organizations—Engineering Division, Box 9 of 11, ASC/HO Archive; Semiannual Report of the Directorate of R&D, AMC, 1 Jul – 31 Dec 1949, AFMC/HO Archive; Lt Col E. N. Ljunggren, Presentation to Committee on Aeronautics of the Research and Development Board, 22 Apr 1950, in Box 3212: B-52 History Supplement, Box 12, ASC/HO Archive.

[37] Ljunggren, Presentation, 22 Apr 1950.

[38] Warden, Interview with Lori Tagg.

[39] Interview with Henry E. Warden by Hugh Ahman, Apr 1993, Columbus, Mississippi. Tapes and transcript available at Air Force Historical Research Agency, Maxwell Air Force Base.

[40] Boykin, Telephone Interview with Lori Tagg.

The Bombardment Branch also consulted with the various laboratories in the Engineering Division and formed a strong partnership with Boeing. In fact, Colonel Warden stressed that the development programs would not have succeeded without the close relationship between the Bombardment Branch and the aircraft manufacturer: "Once the contractor was determined, we felt that we had a single objective to make that the best weapon system possible. In order to do that, we had a team effort that I felt was unequaled."[41]

Unlike the partnership with industry, the relationship between the Branch and the Wright Field laboratories was not as strong. Colonel Warden viewed the laboratories as advisors:

> "We took the position that we were supposed to utilize any technical help we could get. …The labs would come in and tell [us], 'This is what you ought to do,' engine-wise or propeller-wise. The project guy would sit there and it flowed through him. I operated differently. I took the view that the labs were like lawyers. You call a lawyer in to advise you on what to do, not to make a decision. They were there to advise me on the implications of decisions, [but] I would make the decisions. …And the laboratories did a real good job in a lot of things, but they also had vested interests."[42]

In reference to the labs' vested interests, Warden and Boykin referred to the development of aircraft at Wright Field as the "Vertical Air Force."[43] Each of the laboratories at Wright Field was developing or had development contracts with industry for the various aircraft equipment under their purview. Consequently, each laboratory had only a partial perspective on development as opposed to a particular aircraft as a whole. While the equipment under development might have been state of the art, the lack of a holistic approach between the laboratories and the Aircraft Projects Section meant that the equipment was not necessarily adaptable to aircraft then in development by the Branch. As a result, the Bombardment Branch and the laboratories did not always agree. Colonel Warden stressed, "There was never any hesitation on my part to take the action necessary to keep those programs going. But for the most part, the direction, the choices came from me. …And that was my job, really, to save the B-52. Not once, but several times."[44] Sometimes that meant making decisions contrary to the laboratories' suggestions, but

> "…we would never have made the progress we did had we not done so. The laboratories tended to want to be sure [they knew] how to do something before [they did] it. That is just not the nature of development. All development has risk. If you are lucky, your risk pans out. If you are not, it doesn't, and you are out of the business."[45]

Some prime examples of decisions made against the labs' recommendations included providing the B-52 with tail armament only and making the switch to turbojet engines. The Propeller Lab, in particular, vehemently opposed the latter change because, as Colonel Warden commented, "That was death to them."[46]

Much can be said about the differences between the development of aircraft in the 1940s and development in the latter part of the twentieth century. In fact, many accounts of the B-52 refer to Colonel Warden's authority as more than a four-star general might have today. Nearly 50 years later, Colonel Warden made the following comments regarding his authority:

> "We faced the same projected technological problems that you do today with any program, but we had authorities, either assumed or actual, that permitted us to do a lot of these things without

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[41] *Gathering of Eagles: Research, Development, Test and Evaluation, Pete Warden and John Capellupo*, Video Recording, Jun 1996, on file at ASC/HO.
[42] Warden, Interview with Lori Tagg.
[43] Boykin, Telephone Interview with Lori Tagg.
[44] Warden, Interview with Lori Tagg.
[45] Warden, Interview with Hugh Ahman.
[46] Warden, Interview with Lori Tagg.

> going through the various channels that we go through today. …My problem was getting the thing built and that meant that we had to solve our problems without publicity because it is real easy to cancel a project when it is in the making. …This comes back to the mutual respect and confidence we had with the industry. We were very open in discussing these things together, but we never did bring the outsiders in until we had the answers. …We also had opportunities. [Whether it was because of] the lack of detailed scrutiny, the lack of information, or the lack of computers, maybe, but we were able to go out and try things.[47]
>
> "There has been a lot said about me just arbitrarily taking the bit in my mouth and running. Well, in a large sense that is true, but it implies a complete disregard for authority. And that was not right at all. We usually closed the loop one way or another. Well, we didn't get fired or anything, so I guess we must have. …I am pretty sure that I did not go in and say, 'Hey, I made a decision.' I probably said, 'Look, we've come up with a really better solution to this problem.' …I am not sure what authority I had, really, except I know it was a lot less than I used."[48]

Colonel Warden recounted that the Boeing people put their full trust in him:

> "Every time we would have one of these 'Cancel the B-52' [briefings] we would get on the phone [and have] Boeing send a team back to help develop the technical materiel to produce the briefings. …They'd leave [knowing that] Old Pete Warden would take this thing in and present it to the Pentagon. [A Boeing official once told me that they] never knew what went on back there, but always…they were told to keep going."[49]

Boeing's trust was not misplaced. Colonel Warden and his Bombardment Branch pushed the B-52 through the development process for five years, as shown in the following timeline of important events in the struggle towards production of the United States' longest in-service aircraft. Warden's replacement as Chief of the Branch, Lieutenant Colonel Ernest N. Ljunggren, stated in 1950:

> "[The early history of the B-52] is complicated by the rapid advancements being made in the propulsive field combined with the effort which has been made to assure that the B-52 will offer major gains over the projected end attainments of the B-36. It is believed that this effort will be fully justified and the result is an XB-52 configuration which represents the current state of the art in the strategic field."[50]

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[47] *Gathering of Eagles* video.
[48] Warden, Interview with Lori Tagg.
[49] Warden, Interview with Hugh Ahman.
[50] Ljunggren, Presentation, 22 Apr 1950.

BOEING
AIR FORCE YB-52
STRATOFORTRESS

Chronology of XB-52 Development, 1944-1952

1944

August 15, 1944 The Engineering Division at Wright Field projected its experimental aircraft projects for the five-year period of fiscal years 1946 through 1950. They recommended a design study for a jet-propelled (turboprop) heavy bombardment airplane in fiscal year 1946 to cost $650,000 and development of this airplane to cost $16 million between fiscal years 1947 and 1949.[51]

American researchers had begun development of gas turbine/propeller engines prior to 1940. Estimated as having nearly the same fuel consumption rates as reciprocating engines yet better efficiency at higher altitudes, the turboprop was seen as the most logical next step for long-range aircraft applications, particularly for commercial ventures. Many more years of development were necessary, however, before adequate turboprop engines became available.

While U.S. researchers focused on turboprop engines, their European counterparts studied turbojet engines. Sir Frank Whittle of Great Britain and Dr. Hans von Ohain of Germany developed turbojet engines almost simultaneously in the early 1930s. Von Ohain's turbojet engine was installed in the Heinkel He 178, which made the first turbojet-powered flight in August 1939. Germany's Me 262 fighter, the world's first operational jet fighter, made its first successful turbojet-powered flight in July 1942. In the United States, turbojet engines did not win full support until the early 1940s, and at that time, they were favored only for fighter aircraft because of gains in speed and altitude over reciprocating engines. Because the high fuel consumption of turbojets translated into shorter ranges, the engines were less practical for intercontinental bombers under study in the early to mid-1940s.[52]

Germany's Heinkel He 178 was built around the HeS38 engine developed by Hans von Ohain. Although it made the world's first turbojet-powered flight in 1939, the airplane was not produced in quantity.

Messerschmitt Me 262, a twin jet fighter-bomber manufactured in Germany during World War II. It was the world's first operational jet bomber.

1945

April 1945 The Army Air Forces (AAF) requested that Boeing conduct a design study for a heavy bombardment airplane powered by turboprop engines. Boeing, as well as other contractors, declined to submit proposals because the desired characteristics were "so completely out of line with the state of the art."[53]

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[51] Engineering Division, *Scope and Procedure Plans, Project B-7: Post-War Research and Development Program, Five Year Period, F.Y. 1946 to F.Y. 1950 Inclusive*, 15 Aug 1944, p. 13, in Box 2022: Organizations/Engineering Division, Box 9 of 11, ASC/HO Archive.

[52] James St. Peter, *The History of Aircraft Gas Turbine Engine Development in the United States…A Tradition of Excellence* (Atlanta, Georgia: International Gas Turbine Institute of the American Society of Mechanical Engineers, 1999), pp. 72, 229; Squire Brown, personal communication with Lori S. Tagg, Mar 2003.

[53] Warden, Presentation, p. 3; M. B. Rothman, *Aerospace Weapon System Acquisition Milestones: A Data Base*, (Santa Monica: RAND, 1987), p. 78; Warren E. Greene, *The Development of the B-52 Aircraft, 1945-1953* (WPAFB: Historical Branch, WADC, ARDC, May 1956), p. 3, in Box 3208: B-52 Bomber Files, Box 8, ASC/HO Archive.

June 1945 Air Technical Service Command (ATSC, predecessor of Air Materiel Command [AMC]), with headquarters on Wright Field, was directed by higher headquarters to formalize the military characteristics for postwar bombers. The Bombardment Branch's Lieutenant Colonel Pete Warden and his civilian deputy Art Boykin formulated the three-bomber concept, placing emphasis on the development of the heavy bomber. Despite industry's previous rebuff of the heavy program, the Bombardment Branch at Wright Field was hopeful that a long-range, high-speed, heavy bombardment airplane could be developed. They realized, however, that

> "…development of this type [of] aircraft will necessarily extend over several years, due to the fact its appearance will depend on the length of time required to develop and make available high horsepower gas turbines that will be used to drive propellers and also to obtain a certain amount of propulsive force from the jet exhaust."[54]

Underestimating both the time and cost factors, the Bombardment Branch projected the cost of design studies at $1 million a year for two years, followed by procurement of the turboprop bomber at an estimated cost of more than $25 million over four years.

July 16, 1945 The United States detonated its first atomic bomb—a plutonium-fueled "Fat Man"—at Trinity Site located on the Alamogordo Bombing and Gunnery Range (later part of the U.S. Army's White Sands Missile Range) near Alamogordo, New Mexico. Less than one month later, U.S. B-29 bombers dropped atomic bombs over Hiroshima and Nagasaki. Japan surrendered in early September, bringing World War II to an end. The use of atomic bombs ushered in a new era of warfare and requirements for carrying the huge weapons drove the development of heavy bombers for the remainder of the decade.

November 23, 1945 The AAF issued *Military Characteristics for Heavy Bombardment Aircraft* (see Appendix 2)**.** Requirements for the "high speed, high altitude, long range, land airplane" included:

High speed at tactical operating altitude	450 mph
Tactical operating altitude	35,000 feet
Service ceiling	40,000 feet
Tactical operating radius (takeoff point to target) at design gross weight with 10,000-pound bomb	5,000 statute miles
Average speed for above radius	300 mph
Maximum (internal) bomb load	80,000 pounds[55]

Crew accommodations for at least 12: pilot, copilot, flight engineer, one bombardier-navigator, one radio operator, "the minimum number of fire control operators deemed necessary," and a six-person relief crew.

By this time, the structural limitations of the B-36 and the need for faster bombers were recognized as the Soviets developed faster, more capable, jet fighters. Consequently, the AAF wrote into the characteristics:

> "If, after the above requirements have been met, additional performance may be realized, consideration in the design of this aircraft for utilizing this performance should be given to those

[54] Engineering Division, *Postwar Research and Development Program*, 25 Jun 1945, pp. 28, 31.
[55] This bomb load was for one 80,000-pound atomic bomb in the "Grand Slam" configuration. Alternate bomb load design was to provide accommodations for up to 120 500-pound general purpose bombs.

features such as high speed, armament, and passive protection which will reduce its vulnerability in penetrating heavily defended zones."[56]

1946

February 1946 ATSC issued to industry a Request for Proposals (RFP) for designs to "meet or approximate" the November 1945 characteristics. The requirements were beyond the state of the art, with some experts estimating that development of a suitable (turboprop) engine for the aircraft would take up to 10 years. In fact, at the time, high-performance turboprop engines were still only paper designs.[57] Realizing this, the Bombardment Branch added to the RFP:

> "It is desired that the requirements set forth be considered as a goal and that the proposal be for an interim airplane to approximate all requirements, except that emphasis must be placed on meeting the high speed requirement. Because of the lack of adequate power plants at this time, it will be necessary to make some compromises to design a well-balanced airplane."[58]

According to Warden, this concession was the sole reason industry decided to participate in the program at that juncture.[59] Less than a year earlier, many aircraft manufacturers scoffed at the planned project, stating it was not feasible given the state of the art.

Laurence C. Craigie, shown here as a major general, took a position as Chief of the Aircraft Projects Section at Wright Field in 1941. The following year, when a colonel, he was the first United States military pilot to fly a jet aircraft—the XP-59. Between 1945 and 1947, Craigie served as Chief of the Engineering Division. By 1951, Craigie was the Deputy Chief of Staff for Development in the Pentagon.

March 9, 1946 ATSC was reorganized and redesignated Air Materiel Command (AMC) with headquarters on Wright Field. In 1946, the key organization within AMC for bomber development was the Bombardment Branch of the Aircraft Projects Section, Service Engineering Subdivision of the Engineering Division. The Engineering Division, headed by Brigadier General Laurence C. Craigie, was situated within T-3 Engineering under the command of Major General Benjamin W. Chidlaw.[60] Colonel Warden and Art Boykin continued to head up the Bombardment Branch (see Appendix 1, Charts 5 & 6).

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[56] BG Alfred R. Maxwell, Chief, Requirements Division, AC/AS-3, to AC/AS-4, Subj: Military Characteristics for Heavy Bombardment Aircraft, 23 Nov 1945, in Margaret C. Bagwell, *The XB-52 Airplane* (WPAFB: Historical Office, AMC, 1949), Supporting (Sup.) Document (Doc.) 1.

[57] Boykin, Telephone Interview with Lori Tagg. The first American turboprop engine was under development by General Electric in 1941. The T31 (TG-100) made its first successful flight test with propeller in May 1945. St. Peter, pp. 82, 144-145.

[58] Greene, p. 4; Presentation No. 2, Jan 1949, p. 2, in Greene, Sup. Doc. 7; Col George E. Price, Chief, Aircraft Projects Section, Engineering Division, to Boeing Aircraft Company, Subj: Proposal for Heavy Bombardment Airplane, 13 Feb 1946, in Bagwell, Sup. Doc. 2; Michael E. Brown, *Flying Blind: The Politics of the U.S. Strategic Bomber Program* (Ithaca: Cornell University Press, 1992), p. 126.

[59] Warden, Presentation, 28 Feb 1949, p. 3.

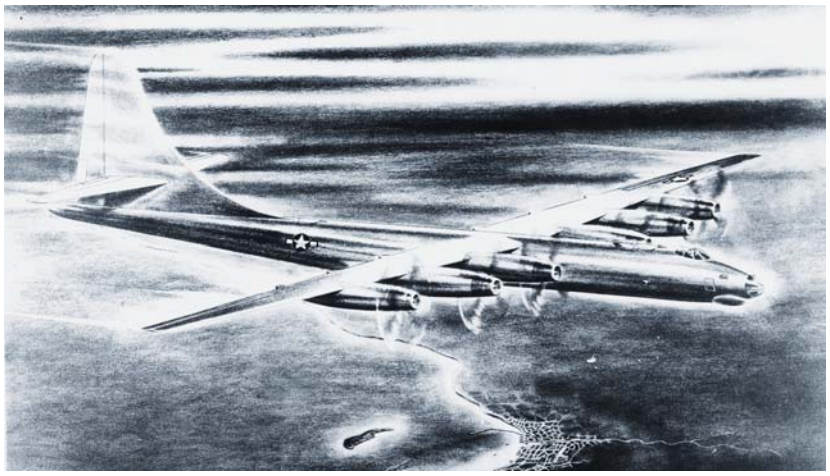
[60] Mark David Mandeles, *The Air Force's Management of R&D: Redundancy in the B-52 and B-70 Development Programs*, Dissertation (Indiana University, 1985), p. 120; AMC Organizational Chart, 1 Dec 1946, and Engineering Division Organizational Chart, 1 Jul 1946, on file at ASC/HO.

April 1946 Boeing Aircraft Company, Glenn L. Martin Company, and Consolidated-Vultee Aircraft Corporation (Convair) submitted designs and cost quotations in response to the February RFP for a heavy bomber.[61]

Boeing submitted a Phase I proposal of $1,785,176 for a 360,000-pound (design gross weight) airplane with a 221-foot wingspan and powered by six Wright T35 turboprop engines. Referred to as Model 462, the straight-wing airplane was estimated to have a cruising speed of 410 mph and a radius of 3,570 miles. As defensive armament, Model 462 had four remotely controlled turrets, each with twin 20mm cannon, and a tail turret with four 20mm cannon. Although the high gross weight was necessary to attain the range and speed proposed, Boeing's model fell short of the range required (5,000 miles radius/13,000 miles range).[62]

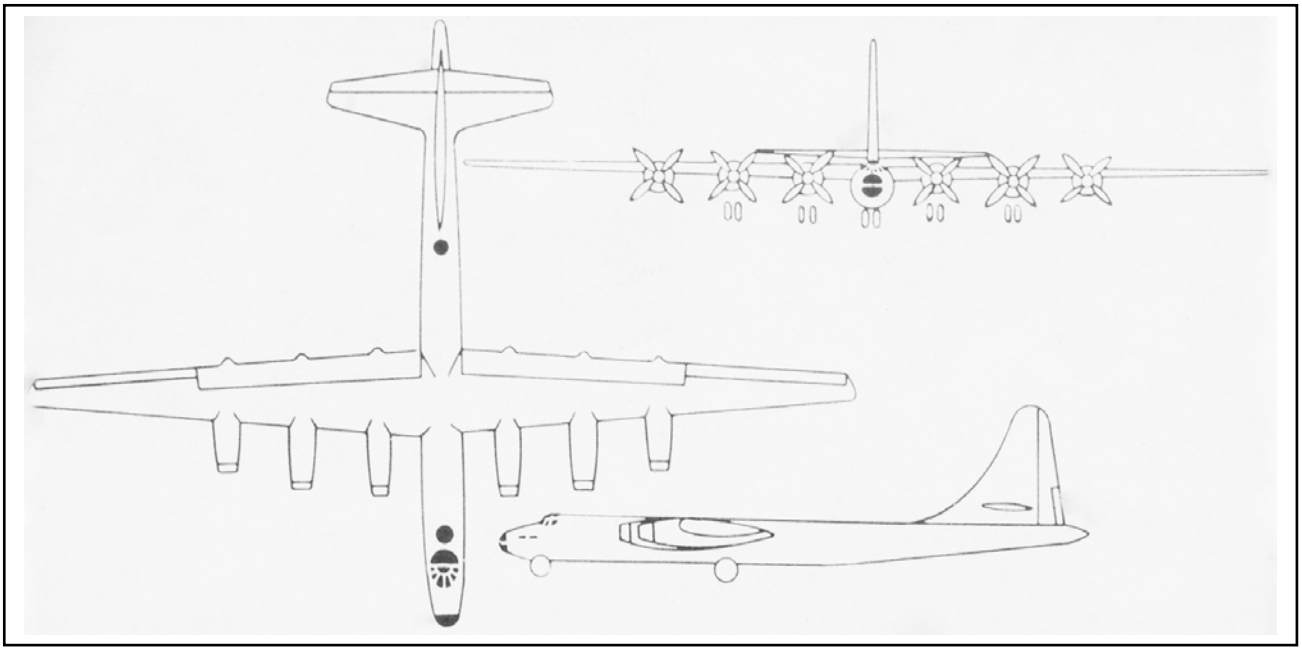
Boeing's model was, by far, the largest aircraft proposed, even heavier than the B-36, which was less than a year away from its first flight (see Appendix 1, Chart 7). Martin's Model 236 proposal was for a 275,000-pound airplane with a 195-foot wingspan, and Convair proposed a 235,000-pound airplane with a 167-foot wingspan. Like Boeing, the two competitors estimated the tactical operating altitude of their models at 35,000 feet, as stated in the military characteristics, but fell short of the range requirement: Martin estimated the radius of its design (carrying a 10,000-pound bomb) at 2,147 miles; Convair estimated 3,189 miles. Average speed of the two models was 364 (Convair) and 407 (Martin) mph.[63] Cost and proposed configuration of these models are not known.

May 23, 1946 General Craigie, Chief of the Engineering Division, recommended that the AAF accept Boeing's design for Phase I development "in view of the results of this evaluation and the outstanding record of Boeing Aircraft Company in the building of heavy bombardment aircraft…." Craigie believed Model 462 represented the best performance per dollar, in addition to "most nearly [meeting] the requirements set forth in Military Characteristics than either of the other two proposals, and further has far greater potentialities." Representatives from the Requirements Division of the Office of the Assistant Chief of Air Staff for Operations and Training (AC/AS-3), who were present at the evaluation, concurred with Craigie's recommendation.[64] During the evaluation, Wright Field considered several criteria, including excellence of design, performance, cost, "productibility," and facilities.[65]



Artist's conception of Boeing's Model 462

[61] Knaack, p. 207; Price to Boeing, 13 Feb 1946, in Bagwell, Sup. Doc. 2.
[62] Rothman, *Acquisition Milestones,* p. 78; William M. Allen, President, Boeing Aircraft Company, to CG, AMC, Subj: CPFF Proposal for Heavy Bombardment Airplane, 18 Apr 1946, in Bagwell, Sup. Doc. 3.
[63] "Summary & Comparison—Performance Data, Heavy Bombardment," in Heavy Bomber General file, Box 3057: Aircraft/Bomber Box 4, ASC/HO Archive.
[64] Bagwell, p. 18; BG L. C. Craigie, Chief, Engineering Division, to CG, AAF, Subj: Design Competition, Heavy Bombardment Aircraft, 23 May 1946, in Bagwell, Sup. Doc. 5.
[65] "Outline of Presentation for Mr. Zuckert, The XB-52 is Used as an Example of One Project," n.d., in Box 3055: Aircraft/Bomber Box 2: Development, ASC/HO Archive.



Three-view diagram of the Model 462 design, Boeing's entry in the November 1945 competition for a heavy bomber

May 29, 1946 **Air Staff authorized AMC to issue a Phase I contract to Boeing for the development of Model 462**.[66] Phase I development included preliminary engineering, wind tunnel testing, engineering of basic systems, mockup, and inspection and approval of the mockup.

June 5, 1946 **AMC informed Boeing that it won the design competition for the heavy bombardment airplane.**[67]

June 14, 1946 **The AAF designated its newest heavy bombardment airplane as the XB-52.**[68]

June 25, 1946 **Northrop's piston-engine, propeller-driven XB-35 flying wing made its first flight.** Initial problems with gearboxes and propellers were fixed, and the aircraft continued its flight test program. A year later, the Bombardment Branch at Wright Field stated, "Sufficient hours in the air have been obtained to prove the feasibility of constructing flying wing type aircraft in the 160,000 pound class. Flights are continuing and will serve to fully evaluate the relative efficiency of this type aircraft."[69]

June 28, 1946 **A Letter Contract (W33-038 ac-15065) was approved awarding Boeing a Phase I contract for preliminary engineering, wind tunnel models and tests, engineering data, and a mockup for Model 462, AAF Model XB-52, Project No. MX-839.**[70]

August 1946 **The XB-52 came under immediate criticism.** The AC/AS-3 stated that the B-52 was "an unrealistic type" primarily because of its huge size.[71] The Bombardment Branch requested that

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[66] Col John G. Moore, Deputy AC/AS-4 to CG, AMC, 29 May 1946, in Bagwell, Sup. Doc. 6.
[67] AMC, Teletype Message to Boeing Aircraft Company, 5 Jun 1946, in Bagwell, Sup. Doc. 9.
[68] "Request for Model or Type Designation," 31 May 1946, in Bagwell, Sup. Doc. 7.
[69] Engineering Division, Post-War Review, 13 May 1947, p. 1, in Box 2022: Organizations/Engineering Division, Box 9 of 11, ASC/HO Archive.
[70] Greene, p. 4; Letter Contract W33-038 ac-15065, in Bagwell, Sup. Doc. 11.
[71] Rothman, *Acquisition Milestones,* p. 78; Bagwell, p. 4.

the Aircraft Laboratory conduct design studies that would allow AMC to inform AC/AS-3 about how speed and range requirements affected the weight of an airplane. These studies were needed to determine possible weight reductions if the original speed and operating radius requirements were reduced.[72]

Not surprising in light of the estimated XB-36 performance data, the fact that Boeing's B-52 proposal did not meet the range requirement brought additional criticisms that would recur over the next several years.[73] Colonel Warden, considering the balance of what is desired versus what is feasible, argued that it was important

> "…to understand the growth potential of a design. …Aircraft designs will grow in range from the initial model through the production models. This may be achieved through improved power plants offering better specific fuel consumption and through overloading the airplane. …If we are faced with building a given airplane in a given weight class and are too ambitious in the initial range requirement without recognizing the range growth, the speed and altitude performance may well be jeopardized."[74]

Northrop's XB-35 flying wing in flight with a Northrop P-61 Black Widow. John Northrop's interest in the design began in the early 1920s, and by 1940, he had manufactured a flyable all-wing aircraft, the N-1M. This eventually evolved into the four-engine XB-35, which had its first flight in 1946. The program was cancelled in 1949.

The XB-36, with six pusher propellers, first took to the air in August 1946. Development of the huge airplane began with a 1941 design competition for an intercontinental bomber. Following a production decision in 1943 (three years before the prototype flew), the Air Force accepted 385 B-36 bombers, including later models augmented with turbojet engines.

August 8, 1946 The Convair XB-36 made its first flight. Development of this bomber began in 1941 when the AAF chose the Consolidated Aircraft Corporation to build an airplane to meet requirements of 10,000-mile range (3,700-mile radius), 275 mph cruising speed, and the capability of carrying a 10,000-pound bomb load. Consolidated's proposal included a straight-wing aircraft powered by six reciprocating engines with pusher propellers. A production decision was reached in June 1943, long before a flyable article was available. War priorities held the program in abeyance, however, until mid-1945, when the production contract was reappraised and upheld. Problems with engine weight, nose gun arrangement, main landing gear selection, and poor workmanship preceded the first flight of the XB-36. By this time, the structural limitations of the

[72] Col George E. Price, Chief, Aircraft Projects Section, Engineering Division, to Maj J. F. Wadsworth, Design Branch, Aircraft Laboratory, Engineering Division, Subj: Heavy Bomber Studies, 13 Aug 1946, in Bagwell, Sup. Doc. 13.
[73] Greene, p. 5.
[74] Warden, Presentation, 28 Feb 1949.

aircraft were well known, and the first flight proved that its earlier performance estimates were overly optimistic.

The Strategic Air Command (SAC) commander, General George Kenney, felt that the performance of the XB-36 was no better than the latest development step of the B-29—the B-50—and recommended decreasing the production order to only a few service test vehicles. Air Staff and the AMC commander, Lieutenant General Nathan F. Twining, overruled Kenney's recommendations, stating that the B-36 was the only aircraft that could fulfill the long-range atomic mission until the B-52 was operational.[75]

August 20, 1946 A conference was held at Wright Field between Colonel Warden and Art Boykin of the Bombardment Branch and representatives from Hamilton-Standard Propellers, Curtiss Propeller Division, the Propeller Laboratory, the Power Plant Laboratory, and Boeing. In order to have an adequate propeller delivered in time for the experimental aircraft, AMC awarded three separate development contracts. This conference was set to determine the propeller reduction gear ratio on Wright Aeronautical Corporation's T35 turbine proposed for installation in the XB-52. Boeing's proposal indicated that new reduction gear development would be necessary to achieve the required propeller speed of the bomber. Because development of the new gear was too long-term to be feasible for the current bomber program, the conferees agreed to use the standard gear ratio.

Colonel Warden stressed the "importance of proper planning of the propeller development, such that tested and proven propellers would be available ahead of the delivery requirements on the XB-52." Both propeller companies estimated that they would need up to 15 months to develop and deliver a type test propeller and an additional six months to deliver enough propellers to supply one airplane. Additional discussion about the optimum diameter of the propeller was shelved until more design studies could be completed.[76]

September 1946 A review of heavy bomber characteristics was recommended by AC/AS-3 and AC/AS-4 (Assistant Chief of Air Staff for Materiel, Maintenance, and Distribution) "with the view of arriving at more realistic performance criteria which are within the capabilities of the industry to meet." The primary reason for the review was "the indication that a heavy bomber airplane of the range required by the Air Forces cannot be met without prohibitive size unless other currently specified performance criteria are reduced."[77] This decision reflected heavy influence by the Engineering Division, which directed its laboratories a month earlier to conduct studies proving out this theory.

October 17-18, 1946 In response to the September recommendation, a conference was held at Wright Field with AC/AS-3 personnel on the XB-51, XB-52, XB-53, and military characteristics in general. Air Staff again expressed its dissatisfaction with the size of the XB-52. AMC representatives indicated that the airframe accounted for roughly 29 percent of the gross weight of an airplane. The remainder of the weight was divided among power plants, armament, equipment, bombs, fuel, and other items

> "…principally controlled by the AAF and…a direct result of particular military characteristics. Therefore, a criticism of the overall weight of an airplane is really a criticism of one or more of the items making up the military characteristics."

In response to Air Staff's concerns about weight, Boeing proposed the smaller Model 464, powered by four Wright T35 engines and weighing approximately 230,000 pounds. This model was estimated to have a 2,500-mile radius (half of the original design requirement) and 400 mph cruising speed at 35,000 feet.

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[75] Knaack, pp. 4-14.
[76] Conference Minutes, 20 Aug 1946, in Bagwell, Sup. Doc. 14.
[77] Routing and Record Sheet, MG E. M. Powers, AC/AS-4, to AC/AS-3, Subj: Presentation of 1948 R&D Budget, 19 Sep 1946, in Bagwell, Sup. Doc. 15.

General Craigie, Chief of the Engineering Division, strongly recommended acceptance of the 464, but Air Staff officials decided to withhold action until they could discuss it with others at the Pentagon.[78]

General Curtis E. LeMay had a long colorful tenure in the Air Force, entering in 1928 as a flying cadet and retiring 37 years later as Chief of Staff. After a varied tour of duty during World War II, he came to Air Materiel Command at Wright Field, and later he went to the Pentagon as the first and only Deputy Chief of Staff for Research and Development. Between 1948 and 1957, he commanded Strategic Air Command.

November 27, 1946 A conference was held in the Pentagon with Major General Curtis LeMay, the Deputy Chief of Staff (DCS)/Research and Development; Major General Edward M. Powers, AC/AS-4; Brigadier General Alfred Maxwell, Chief of the Requirements Division in AC/AS-3; and representatives of Boeing. Again, the weight issue of the XB-52 was paramount. At this time, General LeMay

> "…outlined the requirement…for a special task force of 5,000 mile airplanes capable of dealing a heavy blow from secure North American bases in the event that outlying bases were rendered untenable at the outbreak of war. However, he also outlined a number of requirements concessions which so altered the design concept of the heavy bomber that the Boeing representatives now believe[d] that such a special bomber [could] be constructed to weigh not much more than 300,000 pounds."

Boeing's proposal in response to LeMay's concessions was for an airplane designed specifically around the atomic bomb. This allowed them to drop the requirement for an alternate bomb load; drop all-around armament in favor of tail armament only; and reduce crew size, equipment, comfort, and furnishings to the bare minimum. Boeing also considered the possibility of dropping part of the main landing gear after takeoff. The result was an aircraft with a minimum tactical operating radius of 5,000 miles (approximate range of 13,000 miles[79]) and a high cruising speed of 400 mph. "It can be seen that this completely alters the design concept of the airplane from a general purpose, flexible, completely armed, alternate range with bomb load type of bomber." Boeing cautioned, however, that they anticipated significant design problems and recommended that they first build a high-speed medium bomber (the Model 464) as a successor to the B-50.

The conferees rejected Boeing's warnings (and AMC's recommendations) for an interim medium bomber and instead agreed to continue design studies of a heavy bomber under the XB-52 contract "in accordance with General LeMay's requirements." Boeing was given two months to return with preliminary design data and the estimated size of their "minimum design" aircraft.[80]

December 7, 1946 General Powers, AC/AS-4, requested that AMC change Boeing's contract to include continued Phase I study on the general-purpose heavy bomber (the XB-52) in addition to design studies for a special weapons bomber with a 5,000-mile radius and 400 mph cruising speed as outlined by General LeMay the previous month.[81]

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[78] MG L. C. Craigie, Chief, Engineering Division, to AC/AS-4, Subj: Conference at Wright Field with AS-3 Personnel, 26 Nov 1946, in Bagwell, Sup. Doc. 17.
[79] The formula typically used to determine the range was Range = 8/3 Tactical Radius, not including climb.
[80] BG Alfred R. Maxwell, Memorandum for Gen Partridge, Subj: XB-52 Contract, 27 Nov 1946, in Bagwell, Sup. Doc. 18.
[81] Bagwell, p. 5; MG E. M. Powers, AC/AS-4, to CG, AMC, Subj: XB-52, 7 Dec 1946, in Bagwell, Sup. Doc. 19.

1947

January 1947 One of the ongoing controversies of the XB-52 revolved around requirements for defensive armament. General LeMay asked for a re-examination of this issue on bombardment aircraft "in light of the British decision to carry no defensive armament in their projected 2,500 mile radius…[very heavy bomber] designed to operate at a Mach. No. of .87 [645 mph]." The value of increased speed was noted for restricting the effectiveness of fighter attacks against a bomber "to a narrowing tail cone which decrease[d] proportionately with the increase in speed." At this point, all-around firepower was a requirement in the XB-52 because of its low speed (300 mph cruising). However, according to Major General Earle E. Partridge, AC/AS-3, "Every compromise is being made in favor of speed over defensive armament."[82]

The Armament Laboratory at Wright Field studied several armament configurations ranging from tail or nose fixed guns to wing tip or fuselage turrets. Colonel Leighton I. Davis, Chief of the Laboratory, stated:

> "[T]he fire power of a bomber is lethal against fixed gun fighters attacking mostly from the nose or from the tail. If the enemy uses a fighter carrying a turret these limitations vanish and the fighter and the bomber are on equal footing except for [the] number of guns that can be brought to bear, relative target areas and the element of surprise. …In conclusion it may be [stated] with reasonable accuracy that nose and tail protection is adequate against fixed gun fighters. Against turreted fighters all around protection is necessary. The decision as to whether or not all around firepower must be provided is a function of what is anticipated in enemy airplanes during the tactical life of the bomber under consideration."[83]

January 7, 1947 A conference was held in Washington, D.C., with representatives of AMC, Boeing, AC/AS-4, and AC/AS-3, to evaluate Boeing's newest proposals for the XB-52 as requested by Generals LeMay and Powers in December 1946. Boeing presented two new models: 464-16 and 464-17.

Model 464-16 was a specialized, very heavy bomber with a maximum gross weight of 480,000 pounds, designed to carry only a 10,000-pound nuclear weapon at least 12,000 miles at a speed of 420 mph. Because the remainder of the fuselage contained permanent fuel tanks, this model had no alternate bomb load provisions. Without armament and defensive firepower, Model 464-16 was estimated to have a 13,800-mile range (approximately 5,100-mile radius). Carrying armament, range decreased to an estimated 12,800 miles.

Model 464-17 was basically the same airplane, but had an alternate bomb load capacity of up to 90,000 pounds. At a gross weight of 400,000 pounds and carrying a maximum bomb load, the range of the airplane was estimated to be only 5,200 miles (1,950 miles radius) at 420 mph. At the same gross weight, but with only a 10,000-pound bomb, the range increased to 10,200 miles (3,800 miles radius). Both models were powered by four T35 turboprop engines.

Boeing's research indicated that little improvement in range would be gained by choosing the "minimum design" bomber. Therefore, the attendees decided against the two-bomber plan and chose only Model 464-17 for further development as the XB-52. Boeing's contract was changed accordingly.[84]

The XB-52, now as Model 464-17, continued to suffer criticism from its detractors. Critics attacked the aircraft's size, claiming it was too large to be able to escape from enemy interceptors.[85] Furthermore, the range, while carrying the maximum bomb load, was far below requirements, although Boeing claimed the desired radius of 5,000 miles was easily met with the use of droppable external fuel tanks. The possibility of

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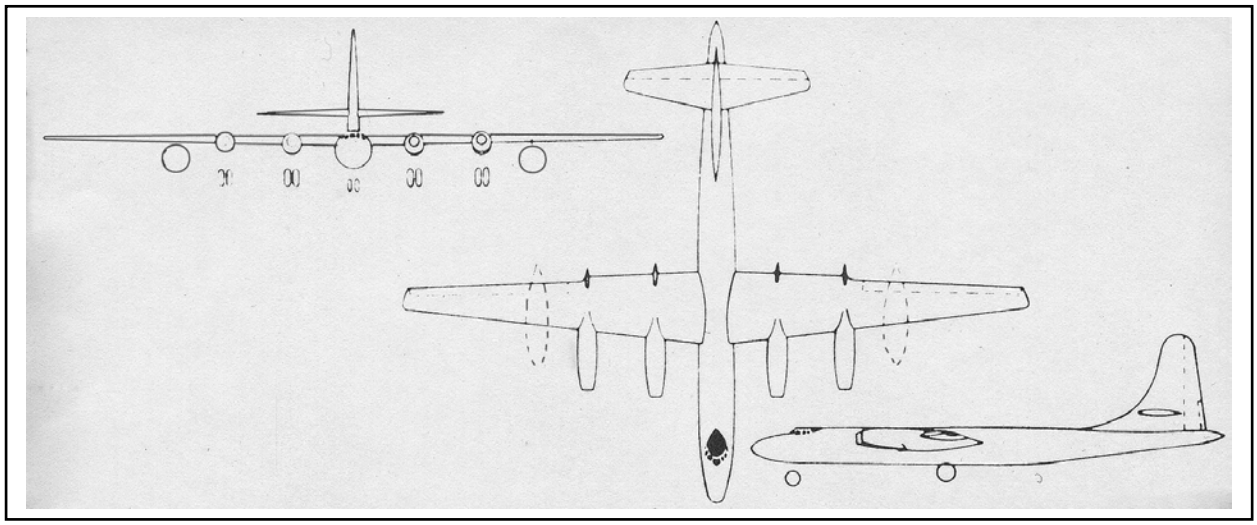
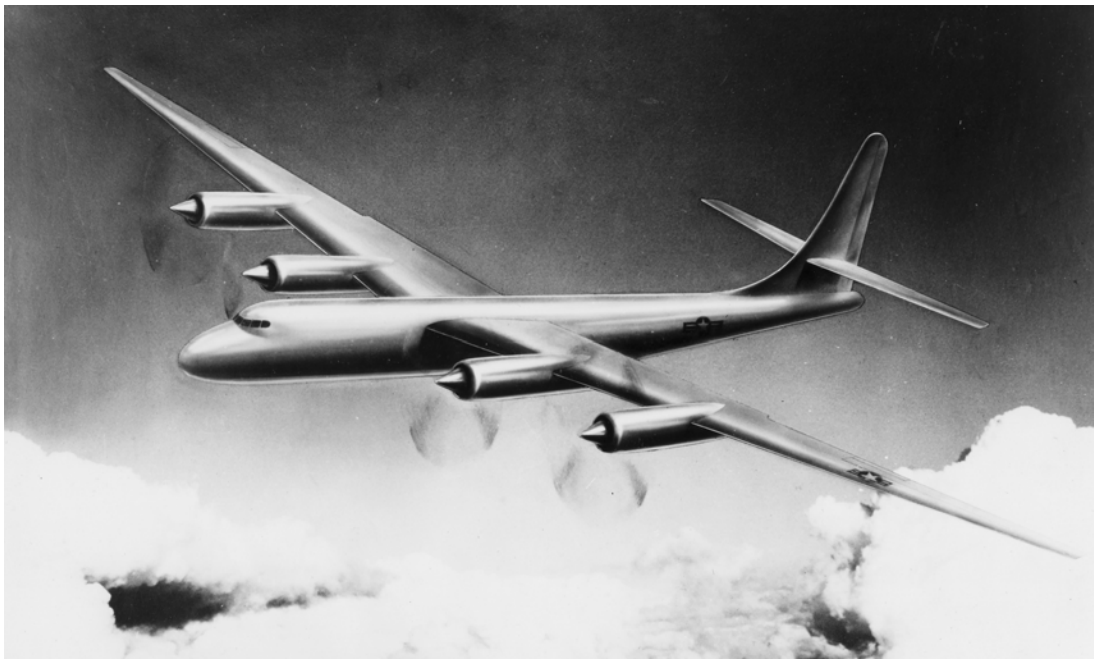
[82] Memo for Gen LeMay, Subj: Defensive Armament in Bombardment Aircraft, 5 Mar 1947, in Bagwell, Sup. Doc. 31.
[83] Col L. I. Davis, Chief, Armament Laboratory, Engineering Division, Routing and Record Sheet: Defensive Fire Power Requirements for Bombardment Aircraft, 28 Jan 1947, in Greene, Sup. Doc. 1.
[84] Maj W. C. Brady, Memorandum for Record: XB-52 Conference, 7 Jan 1947, in Bagwell, Sup. Doc. 21; Rothman, *Acquisition Milestones,* p. 78; Boeing, *Development of the B-52 Airplane*, Boeing Document D-13009, 15 Mar 1952, p. 10; MG E. M. Powers, AC/AS-4, to CG, AMC, Subj: XB-52, 21 Jan 1947, in Bagwell, Sup. Doc. 24.
[85] Greene, p. 5.





Three view diagram and artist's conception of Boeing's Model 464-17, a four-engine general bomber proposed for the B-52 in January 1947

dropping part of the main landing gear after takeoff was censured by the Aircraft Laboratory, which determined that the actual weight savings would be minimal, "inasmuch as extra weight would be required for the jettisoning gear and apparatus, including extra weight in fittings, mechanisms, quick removable pins…, etc."[86]

January 31, 1947 For protection against enemy interceptors, the AAF decided to continue studies of placing a parasite (stowed) fighter within the bomb bay of the B-52. Such a program was already underway for the B-36. The tiny McDonnell XP-85 (XF-85) Goblin, with a wingspan of 21 feet and a weight of only 4,550 pounds, was to be carried in the bomb bay of the intercontinental bomber. Released at the first sign of enemy fighters, the turbojet-powered Goblin could spend 20 minutes aloft at a maximum

[86] Routing and Record Sheet, Subj: Landing Gear Requirement for Very Large Airplanes, 13 Jan 1947, in Bagwell, Sup. Doc. 23.

speed of 650 mph. The single-seat fighter was armed with four .50-caliber machine guns. After the danger passed, the parasite would be recaptured by the B-36 mother ship.[87]

A similar program for the B-52 had been contemplated, but in November 1946, General LeMay had ruled out this possibility, preferring instead to rely on the "surprise attack" of a specialized bomber. However, the Requirements Division in AC/AS-3 was buoyed by the promise shown by the Goblin and believed that such work should continue, particularly for the XB-52's shorter-range missions (when not carrying a nuclear weapon). Further missions were considered for these parasites, such as countermeasures carriers or as drones to simulate larger formations of bombers. AMC was directed to study the feasibility of this configuration for future medium and heavy bombers.[88]

The McDonnell XP (XF)-85 Goblin was developed in 1945 as an escort fighter to be carried internally by the B-36. First flight of the tiny fighter occurred in August 1948, but the airplane was never approved for production.

February 4, 1947 A conference was held at Wright Field to discuss propeller requirements for the XB-52. Representatives of AMC, Boeing, Aeroproducts, Wright Aeronautical Corporation, Curtiss-Wright Propeller Division, and Hamilton-Standard Propellers agreed that a four-bladed, single-rotation propeller with a 23-foot diameter would be most suitable for the T35-3 engines to be installed on the airplane. Further performance characteristics included a 650-rpm cruising condition at a turbine speed of 7,080 rpm.[89] The primary issue was how to get the propeller to interface with the engine. The Bombardment Branch was particularly concerned about the size of the propeller needed for the XB-52. Boykin remembered the "pioneering work" on the 19-foot propellers for the XB-36, and expressed concerns over possible stress and flutter problems that might be experienced with the XB-52's larger propellers.[90]

The minutes of the meetings with the engine and propeller manufacturers gave no indication of the underlying tension that was present. The Boeing engineers reflected that the various manufacturers did not want to talk about their projects in front of their competitors and tempers flared over who was responsible for particular parts, such as the shaft that held the propeller on the engine.[91] The propeller manufacturers were each developing a different method of retaining the blade in the hub. Colonel Warden recommended standardizing this method, "so that if we had a good hub and a bad blade, we could interchange and make something out of it. Boy, …they weren't talking about that."[92] When Colonel Warden, frustrated with the

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[87] Knaack, p. 313; Jon Guttman, "McDonnell XP-85 Goblin," *Aviation History* 12 (2) Nov 2001, viewed online 28 January 2003 at http://preview.thehistorynet.com/aviationhistory/articles/2001/11012_cover.htm.
[88] BG A. R. Crawford, Chief, Research and Engineering Division, AC/AS-4, Routing and Record Sheet: Internally Stowed Fighters, 31 Jan 1947, in Bagwell, Sup. Doc. 26; Crawford, to CG, AMC, Subj: Internally Stowed Fighters for XB-52, 20 Mar 1947, in Bagwell, Sup. Doc. 35.
[89] Report: XB-52 Power Plant-Propeller Conference, 24 Feb 1947, in Bagwell, Sup. Doc. 30.
[90] Boykin, Telephone Interview with Lori Tagg.
[91] American Institute of Aeronautics and Astronautics, *Launching the B-52: Research and Design*, Part 1, 17 May 1982, Video Recording, on file at ASC/HO.
[92] Warden, Interview with Lori Tagg.

lack of cooperation, suggested dropping the propeller and switching to turbojet engines, both the engine and propeller manufacturers stressed that they could overcome the difficulties, but it would take a minimum of four years.[93] SAC wanted the airplane in operation as early as 1954, as that was generally believed to be the end of the operational usefulness of the B-36.

March 1947 **The Armament Laboratory concluded its study on the best defensive armament configuration for the XB-52.** Their recommendations called for "…wing tip turret gunners in the wing tip turrets. Tail protection is obtained by the installation of a separate 4-gun tail turret with the gunner located in a tail cab." They also stated, however, that

> "…a project is now underway to determine whether or not physiological and psychological conditions at the wing tip will permit the placement of gunners at that location. In the event that an inhabited wing tip installation is not feasible, it will be necessary to resort to other remote sighting means now under development or to the use of periscopic sights in the fuselage."[94]

March 8, 1947 **Pratt & Whitney began development of the JT3-6 turbojet engine, which, along with concurrent development work on the XT45 turboprop, evolved into the J57 engine.** Prior to this time, Pratt & Whitney's limited experience with turbojet engines was in the "Americanization" of two British engines with centrifugal compressors, the Rolls-Royce "Nene" (J42) and the Rolls-Royce "Tay" (J48). The JT3 was designed with dual-spool, axial compression to provide performance flexibility, allowing the engine to operate efficiently despite changes in speed and power settings.[95]

April 15, 1947 **AC/AS-4 directed AMC to "determine characteristics for the largest air-to-surface missile, which will meet present air-to-surface missile military requirements, which may be carried in the B-52 without modifying the bomb-bay."** Specifically, Air Staff requested that AMC determine the feasibility of the B-52 carrying Bell's air-to-surface missile, the Rascal.[96]

The Bell B-63 Rascal was an air-to-surface nuclear guided missile, development of which began in 1946. A Rascal was first launched from a DB-47 in 1953 and, by 1958, more than 100 were ready for deployment to SAC. The Rascal program was cancelled in favor of Hound Dog missiles that were eventually carried on the B-52.

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[93] *Launching the B-52,* Part 1, Video Recording.
[94] Col L. I. Davis, Chief, Armament Laboratory, Engineering Division, Routing and Record Sheet: Defensive Fire Power Requirements for Bombardment Aircraft, 24 Mar 1947, in Greene, Sup. Doc. 2. No further information could be found on this project. It is assumed that wing-tip turrets were determined to be impractical.
[95] St. Peter, pp. 173-174.
[96] BG F. O. Carroll, Chief, Research and Engineering Division, AC/AS-4, to CG, AMC, 15 Apr 1947, in Bagwell, Sup. Doc. 36, p. 3. For additional information on the Rascal program, see Jacob Neufeld, *The Development of Ballistic Missiles in the United States Air Force, 1945-1960* (Washington, D.C.: Office of Air Force History, 1990).

April 17, 1947_ The Engineering Division recommended that the XB-52 project continue into Phase II at a cost of $2.9 million. Boeing had submitted its Phase II proposal on February 14, 1947, and an additional request for Phase II work on "design and construction of an experimental nacelle and suitable supporting structure on which to mount the complete power plant assembly" was submitted on March 7. The additional work was estimated at $999,765.[97]

April 21, 1947 The XB-52 faced its first big competitor when AC/AS-3 supported Project RAND's conclusions that "cast doubt on the ability of the XB-52 to reach a 5000-mile tactical radius of action with 10,000 pounds of bombs…." Project RAND, an acronym for Research And Development, began as a contract with Douglas Aircraft shortly after World War II. The "think tank" was charged with conducting research on pressing military problems and informing Air Staff of possible solutions. RAND researchers held quarterly briefings for Air Staff in Washington, D.C., and similar presentations were often given at AMC in Dayton.[98]

Basing their conclusions on range-payload studies for heavy transport airplanes, RAND concluded that the Bombardment Branch and Boeing had missed the weight estimate by two percent. If the range and speed requirements remained constant, then the gross weight of the airplane would have to be increased appreciably, especially if payload was increased. RAND's study indicated that the XB-52 would weigh between 600,000 and 1,000,000 pounds when carrying a 22,000-pound bomb.

Furthermore, RAND proposed that significant gains in range would be possible if a smaller fuselage was used in conjunction with streamlined external pods for fuel and bombs. General Alfred Maxwell, Chief of the Requirements Division of AC/AS-3, stated, "This theory definitely disagrees with the latest Boeing studies which showed no significant range would be gained by designing a minimum sized, special purpose XB-52." Maxwell also noted Boeing's intent to stick with the conventional fuselage "in spite of the fact that all indications so far greatly favor the more efficient flying wing design, such as the B-35," or even a "Delta Type design." Maxwell charged that

> "…the Boeing estimates are far more optimistic than the Douglas Company and it is significant that the optimistic figures are being put out by the Company who has the greatest self-interest in the matter. …It looks as if we are on very thin ice, considering the ultimate cost of this project, when such serious disagreement exists between the Boeing Company and a competent engineering staff (Douglas)."[99]

With a cooler head, Brigadier General Alden R. Crawford, Chief of the Research and Engineering Division of AC/AS-4, responded to Maxwell that "[w]hile [RAND's] conclusions are somewhat alarming, the accuracy of the curves on which their conclusions were based are probably only of value in showing trends rather than finished detailed information." Boeing and Northrop were preparing analyses of their respective configurations for further study by RAND, as well as more conclusive studies of the new delta-wing configuration. "It is not believed, however, that these studies are sufficiently conclusive to warrant incorporation in the XB-52 without considerably more detailed investigation." Crawford suggested waiting for AMC's comments on the matter.[100]

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[97] Boeing Aircraft Company to CG, AMC, Subj: CPFF Proposal for Heavy Bombardment Airplane, AAF Model XB-52 (Boeing Model 464-17), Phase II, 14 Feb 1947 and 7 Mar 1947, in Bagwell, Sup. Docs. 28 and 32.

[98] Collins, *Cold War Laboratory*, p. 170. In 1948, Project RAND separated from Douglas to become the independent, nonprofit RAND Corporation.

[99] Routing and Record Sheet, Subj: XB-52 Performance, 21 Apr 1947, in Bagwell, Sup. Doc. 38; MG E. M. Powers, AC/AS-4, to CG, AMC, Subj: XB-52, 25 Apr 1947, in Bagwell, Sup. Doc. 40.

[100] Routing and Record Sheet, Subj: XB-52 Performance, 23 Apr 1947, in Bagwell, Sup. Doc. 39.

Alden R. Crawford was appointed Chief of the Research and Engineering Division in the Office of the Assistant Chief of Staff for Materiel in 1945. In August 1947, he became Chief of the Engineering Division at Air Materiel Command, Wright-Patterson Air Force Base. (*Air Force Materiel Command History Office*)

Alfred R. Maxwell, a former test pilot from Wright Field, served as Chief of the Requirements Division, AC/AS-3, from July 1945 to July 1947. He later became Vice Commander of Air Research and Development Command. (*Air Force Materiel Command History Office*)

AMC's 14-page response came nearly two months later, and Colonel Warden traveled to Washington, D.C., to respond directly to RAND's study. He initially agreed with RAND's conclusions:

> "They're absolutely right, in a sense. … [I]f the weight has to be two percent larger, then you have to make the engines bigger, everything else bigger, and that is what it winds up [a 600,000-pound airplane]. But in real life, that is not what happens. [If, when] you start out, you are going to go 5,000-mile radius and you miss the weight by two percent, you are now only going to go 4,950-mile radius with the same airplane that still weighs 400,000 pounds."[101]

The Bombardment Branch's written response supported the basic XB-52 design as "well balanced." It recommended that, if "an adequate weight control program be instituted and enforced," the ultimate range objective for the airplane could be met. The Branch concluded that the XB-52 program was being delayed due to a lack of unity in all branches of the AAF on the 5,000-mile radius requirements of the airplane, "a full realization as to how such a requirement will automatically dictate an airplane of tremendous size and weight," and "a willingness on the part of all branches of the AAF to accept the compromises which are absolutely necessary if a successful design is to be evolved to meet the primary range objective of the project."[102]

General Craigie, Chief of the Engineering Division, agreed with the Bombardment Branch's conclusions. He compared the XB-52 to both the B-29 and B-36 programs in his recommendation to provide the XB-52 with high priority:

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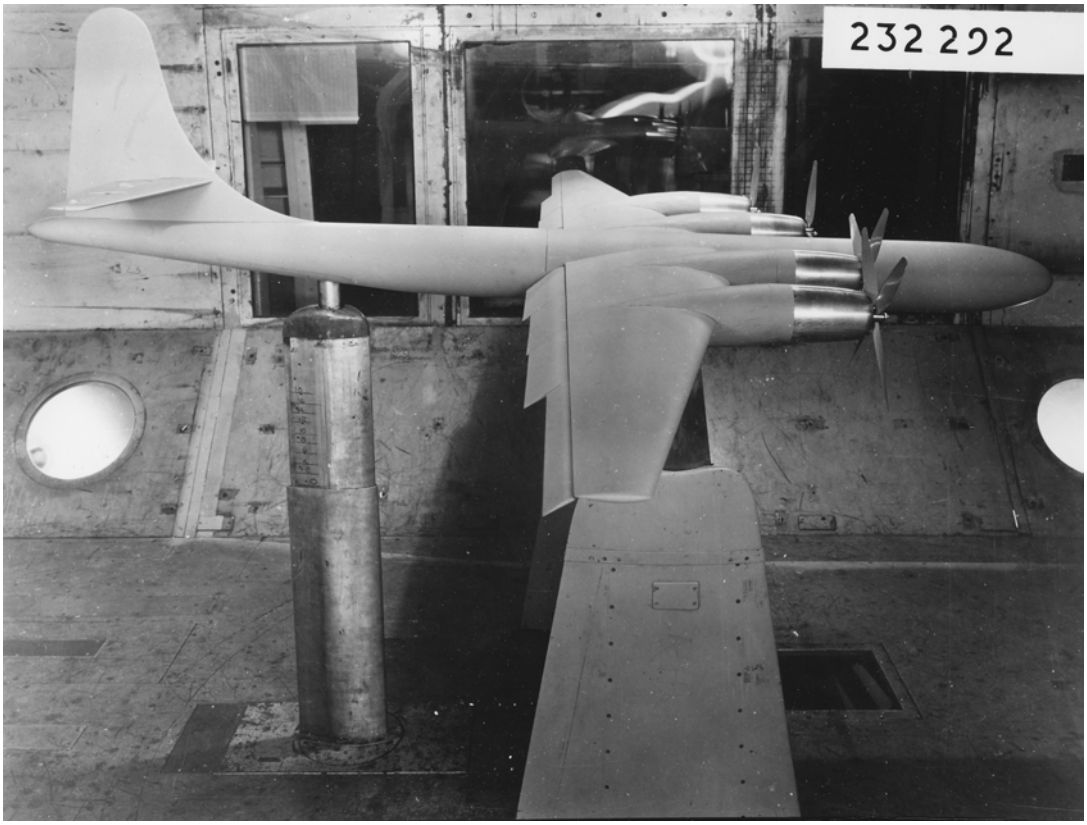
[101] Warden, Interview with Lori Tagg.
[102] J. A. Boykin, Memorandum Report on Analysis of the XB-52 Project, 23 Jun 1947, in Bagwell, Sup. Doc. 51.

"It is immediately apparent that had either of these projects' suitability been based solely on the initial design point, both would have been cancelled prior to completion of the first experimental article. This comparison is made in order that any temporary deficiency of the XB-52 not be allowed to cloud the potentialities of the design and the possibility of ultimate attainment of the design range."[103]

May 2, 1947 Air Staff informed AMC that it would not concur with their April 17 recommendation to begin Phase II until Phase I wind tunnel tests were completed. They requested further evaluation and justification before they agreed to spend another $2.9 million.[104]

May 15, 1947 In a letter to General Twining, Commanding General of AMC, Major General Curtis LeMay, DCS/Research and Development, voiced his feelings about the B-52:

"I feel that the B-52, or any other airplane capable of doing the job for which the B-52 is intended, will of necessity be of such size and of such cost that neither the aircraft industry nor our future budget will permit its production and procurement on other than a very limited scale. What this exact figure may be, I do not profess to know, however, I guess it at about one-hundred (100) articles. These airplanes, utilizing atomic bombs, would be used to initiate retaliatory combat



Turboprop B-52 model in wind tunnel test, location unknown, August 25, 1947

[103] Gen L. C. Craigie, Engineering Division, to AC/AS-4, Subj: XB-52 Airplane, 11 Jul 1947, in Bagwell, Sup. Doc. 53.
[104] BG Alden R. Crawford, Chief, Research and Engineering Division, AC/AS-4, to CG, AMC, 2 May 1947, in Bagwell, Sup. Doc. 37, p. 2.

> operations from North American bases, as soon as hostilities start. Such operations would obviously be on a small scale, due principally to the limitations of the atomic bomb stock pile, limited number of carriers available and the complications of operating at such long ranges from the U.S.
>
> "…I am somewhat concerned over the B-52 as presently conceived, since attainment of its designed speed and range characteristics appear absolutely dependent upon the successful development of the T35-3 engine. I believe that we have at least six months to go before a committing final decision as to the B-52 will have to be made, in order to be assured that only limited funds will have been spent before cancellation."

General LeMay recommended that the AAF consider proposals from "the late starters" (Douglas, Northrop, and Consolidated) despite the fact that those companies had either not bid on or won the original heavy bomber competition in 1946. He felt it was the only way "to make sure that if the B-52 is the horse we intend to back, such action is firmed after all other possibilities have been considered and eliminated." LeMay cited that his views pretty much "summed up the views of the majority here in the Air Staff."[105]

- **June 2, 1947 AMC assured Air Staff that fabrication of components would not begin until the wind tunnel program was completed and the mockup was inspected and approved.** It also identified the $2.9 million slated for Phase II as funds scheduled for the XB-52 after the 1947 budget reduction.[106] Consequently, despite General LeMay's concerns, Air Staff approved Phase II of the XB-52 at $2.9 million on June 16.[107]

- **June 19, 1947 The Engineering Division recommended dropping the requirement for the XB-52 to carry an internally stowed fighter because it would "seriously [compromise] the primary long range mission" and cause a "tremendous increase in gross weight."** Noting that Air Staff had directed all other requirements subordinate to the extreme range requirement, AMC believed that the structural rearrangement necessary to adapt the folding-wing stowed fighter to the XB-52's bomb bay would involve a severe weight penalty and thus reduce the range of the heavy bomber.[108]

- **June 23, 1947 The AAF issued new military characteristics for the heavy bomber to replace those issued in November 1945** (see Appendix 3)**.** These new requirements focused specifically on higher cruising speeds: a high speed of 420 mph (30 mph less than in 1945) at tactical operating altitude of 35,000 feet and an average speed of 400 mph for a 5,000-mile tactical operating radius (100 mph faster than in 1945).[109]

- **July 14, 1947 General LeMay again expressed his thinking on the subject of the XB-52 to AMC, illustrating that no firm decision had yet been made on the heavy bombardment issue.** He indicated that, although Air Staff directed development of the XB-52 as a high priority,

> "[t]he XB-52 is only a study of one method of accomplishing the strategic mission intended for this airplane. This project must be carefully and continuously scrutinized to assure its continuing practicability.

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[105] MG Curtis E. LeMay, DCS/R&D, to LG N. F. Twining, CG, AMC, 15 May 1947, in Bagwell, Sup. Doc. 46.

[106] Truman desired a balanced budget and because his administration believed the United States' vulnerability was more political than military, he decreased defense spending. From $90 billion in 1945, the defense budget was slashed to $10 billion in 1947. Robert A. Pollard, *Economic Security and the Origins of the Cold War, 1945-1950* (New York: Columbia University Press, 1985), pp. 20-23.

[107] BG Alden R. Crawford, Chief, Research and Engineering Division, AC/AS-4, to CG, AMC, 16 Jun 1947, in Bagwell, Sup. Doc. 37, p. 4.

[108] BG S. R. Brentnall, Chief, Engineering Operations, Engineering Division, to CG, AAF, 19 Jun 1947, in Bagwell, Sup. Doc. 49.

[109] BG Alfred R. Maxwell, Chief, Requirements Division, AC/AS-3, to AC/AS-4, Subj: Military Characteristics of Aircraft, 23 Jun 1947, in Bagwell, Sup. Doc. 52; Rothman, *Acquisition Milestones,* p. 78.

"It is directed that consideration and study of other means of accomplishing this primary mission be initiated to explore the following conditions:

(1) One-way flight to the target.
(2) The aircraft's return to friendly territory outside the United States.
(3) Pre-planned ditching areas.
(4) Use of sub-sonic pilotless aircraft manufactured and operated at a greatly reduced cost compared with the great financial and physical effort required by present VHB [very heavy bomber] production-operation methods.
(5) RAND project solutions for this strategic mission.

"The intent of this letter is not to stop progress on the present XB-52, nor to add to its difficulties, but to ascertain that Air Materiel Command understands the possibility of change occurring in this program. The strategic mission remains firm but the method of its accomplishment is not fixed."[110]

July 26, 1947 A National Security Act created the National Military Establishment under a Secretary of Defense. The departments of the Army, Navy, and Air Force were co-equal arms of the military force. The United States Air Force was established within the Department of the Air Force.[111]

July 28, 1947 The Engineering Division contracted with Pratt & Whitney (W33-038 ac-18662) for the development of the XT45 turboprop engine being developed concurrently with the JT3 turbojet. "The XT45 was to be a thirteen-stage axial flow turboprop engine in the 10,000 [estimated horsepower] class utilizing a unique two-spool compressor arrangement." As a backup in case the T35 engines planned for the B-52 did not succeed, the initial XT45 design contract called for "design of the complete engine, construction of a full-scale mock-up and fabrication and testing of engine components to check out the design." AMC authorized the expenditure of $900,000 for this initial contract.[112]

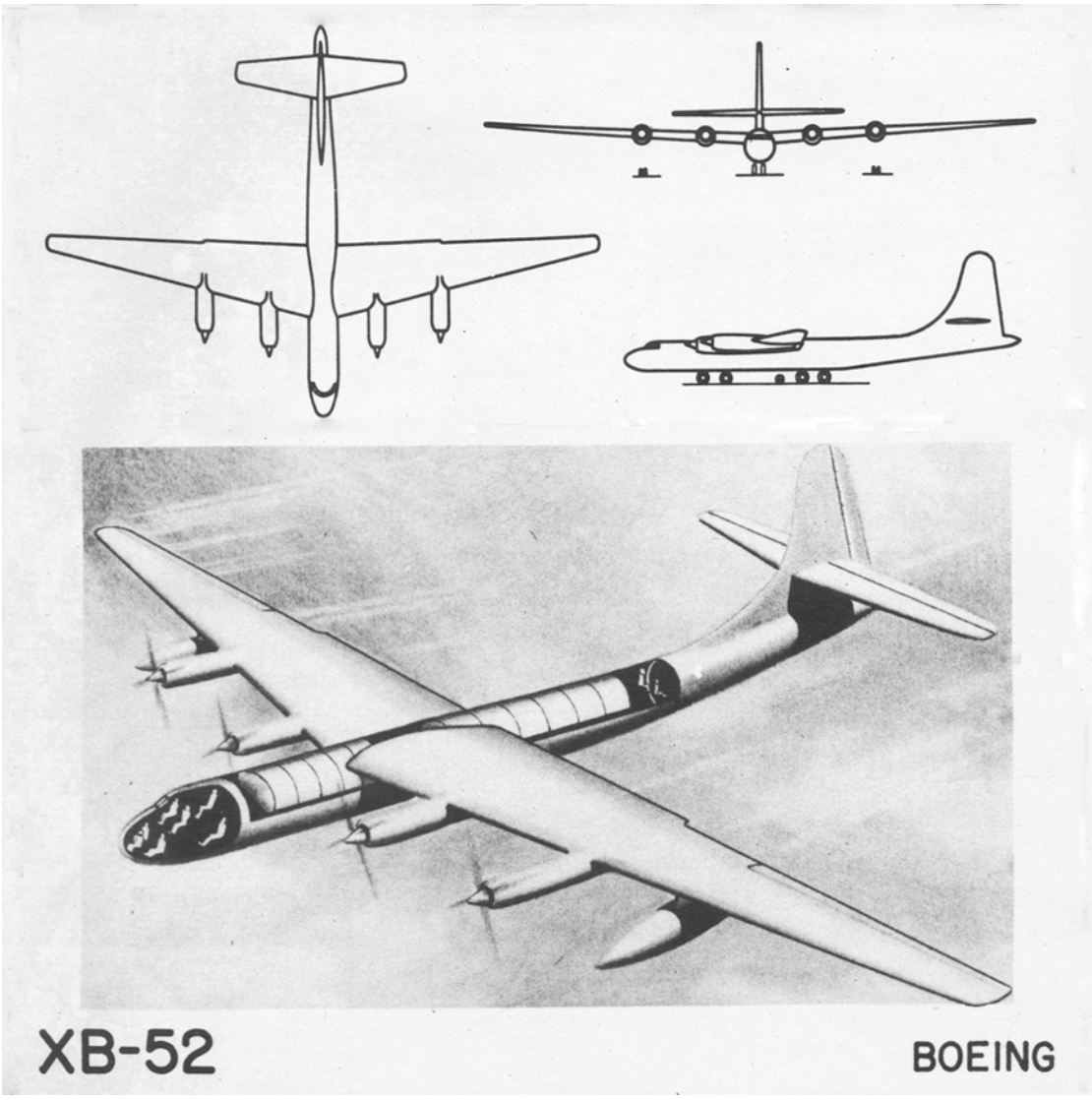
August 1947 The Engineering Division forwarded to the Pentagon the results of Boeing's studies mating the Bell Rascal air-to-surface missile with the B-52 as requested in April:

"The present conception of the Bell MX-776 'Rascal' missile, presented in the Preliminary Design Study, dated 22 May 1947, will fit semi-internally in the B-52 envelope dimensions, with modifications of the bomb bay doors. Portions of the forward and rear horizontal surfaces, and the lower rear vertical surface, would lie in the airstream….

"However, while preliminary information indicates that the present conception of the B-52 might carry one 'Rascal' missile in the bomb bay, as described above, with two missiles mounted on the wings, the B-52 project personnel point out that launching and separation problems with such a high-speed airplane would be so considerable that external stowage might be the only solution to the problem.

"The Bell missile…apparently possesses the optimum characteristics for a missile to be carried internally in a B-52. The main limiting factor of the bomb bay is the width (8′0″) which means that any missile which would fit wholly internally would have very poor range and speed characteristics,

[110] MG Curtis E. LeMay, DCS/R&D, to CG, AMC, Subj: XB-52 Program, 14 Jul 1947, in Bagwell, Sup. Doc. 54.
[111] Walton S. Moody, *Building a Strategic Air Force* (Washington, D.C.: Air Force History and Museums Program, 1995), p. 149.
[112] Technical Accomplishments of the Power Plant Laboratory, Fiscal Years 1946-1951, 3 Sep 1951, pp. 10, 23, Box 4287: Laboratories/Propulsion Box 4 of 19, ASC/HO Archive.



Three-view diagram and artist's conception of Boeing's Model 464-25, successor to the 464-17 and which evolved into Model 464-29 by September 1947

and a warhead weight on the order of 1000 lbs. Past studies have indicated the use of folding wing and control surfaces for internally-stowed missiles, but such a procedure introduces problems that limit its application to subsonic missiles."[113]

August 7, 1947 Boeing submitted its preliminary design data in support of the military characteristics issued on June 23, 1947. Boeing's 400,000-pound Model 464-25 included the following changes over the 464-17:

(1) The use of four main landing gears in the fuselage with nacelle outriggers.
(2) Reduction of defensive armament to one .50-caliber tail turret with radar sighting and two .50-caliber forward turrets with optical sighting.

[113] Col Marshall S. Roth, Chief, Guided Missiles Section, Engineering Division, to CG, AAF, 15 Apr 1947, in Bagwell, Sup. Doc. 36, p. 4.

(3) Large fuel cells with wing rib structure inside the fuel tanks.
(4) Increased bomb load to 12,000 pounds.[114]

Over the next month, Boeing submitted a number of preliminary designs for the XB-52, including the 464-29, a 400,000-pound, straight-wing airplane with an increased speed of 455 mph and a tactical operating radius that met requirements (5,000 statute miles). Although Boeing stated, "this was the first design that achieved the desired range objectives," the Air Force did not accept it prior to the meeting of the Aircraft and Weapons Board the next month.[115]

September 1947 The Heavy Bombardment Subcommittee of the newly created Aircraft and Weapons Board[116] met to reevaluate the heavy bomber requirements, particularly "the problems of building a 480,000 pound airplane with its relatively low cruising speed to deliver the atomic bomb." The subcommittee was made up of representatives from Air Force Headquarters, A-3, A-4, SAC Headquarters, two SAC wings, and AMC's Engineering and Procurement divisions. It also consulted with RAND, Boeing, and the laboratories at Wright Field. The committee's final recommendation called for the adoption of new characteristics that reduced the range from 10,000 to 8,000 miles, increased the cruising speed from 300 to 550 mph, reduced defensive armament to tail only, reduced the crew from 12 to five, and notably, specified that the "airplane must be refuelable in the air."[117] In determining the necessity of aerial refueling, the Heavy Bombardment Subcommittee concluded that

> "…4000 statute miles (3470 n. [nautical] mi.) was adequate to cover the target complexes considered. For reasons of cost and scarcity of fissionable material, this Committee concluded that combat zone performance must be maximized, that "high speed was the basic parameter around which an airplane should be designed for delivery of the A bomb." Out of this 4000 statute mile radius, this Committee considered that 2000 statute miles constituted the combat zone, and that the problem of getting the combat vehicle up to the combat zone in actuality was a logistics problem, and that the performance in the logistics zone need not necessarily be as high as the combat zone. It concluded that refueling should be used for solution of the range problem within the logistics zone, or non-combat zone. It was proposed that the airplane to fulfill this 4000 statute mile (3470 n. mi.) radius should be designed to have a total of 8000 statute miles (6940 n. mi.) range, and that the additional range necessary to define normal warm-up, landing reserves, evasive action, etc. should be accomplished through the use of one refueling on the outbound flight. Combat zone performance would be 500 mph (434 kn.) average cruising speed in the combat zone at an altitude of 35,000 feet."[118]

September 2, 1947 The definitive contract (W33-038 ac-15065) for Phase I of the XB-52 was approved, superseding the letter contract dated June 28, 1946.[119]

September 18, 1947 The first Secretary of the Air Force, W. Stuart Symington, was sworn in and air-related activities transferred from the Army to the newly created Department of the Air Force. General Carl A. Spaatz became the first Air Force Chief of Staff.[120]

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[114] Boeing Aircraft Company, to CG, AMC, Subj: Contract W33-038 ac-15065, Transmittal of Preliminary Design Data, 7 Aug 1947, in Bagwell, Sup. Doc. 59.
[115] Boeing, p. 21; Greene, p. 6.
[116] The Aircraft and Weapons Board had been created in August 1947 at the recommendation of General LeMay, whose position, DCS/R&D, had been eliminated by Chief of Staff Carl A. Spaatz. It was made up of key Air Staff officers and commanders. Collins, *Cold War Laboratory,* p. 173. Also see Moody, *Building a Strategic Air Force*, p. 110.
[117] Rothman, *Acquisition Milestones,* pp. 78-79; Col George F. Smith, Chief, Aircraft Projects Section, Engineering Division, Routing and Record Sheet: Heavy Bomber Design Study, 9 Oct 1947, in Bagwell, Sup. Doc. 65.
[118] HQ, AMC, "XB-52 Presentation: Status-Growth-Production," to HQ, USAF, 10 Nov 1949, in Box 3203: B-52 Bomber Files, Box 3, ASC/HO Archive.
[119] CPFF Supply Contract, W33-038 ac-15065, 2 Sep 1947, in Bagwell, Sup. Doc. 61.

November 6, 1947 Air Staff directed AMC "to withhold further expenditures of funds on the XB-52 in its present configuration" while Air Staff considered its options in the heavy bombardment field. Within two weeks of this directive, the XB-52 program was close to cancellation.[121]

To meet the new requirements issued by the Heavy Bombardment Subcommittee in September, the B-52 needed to be redesigned completely. Many high-level officials favored cancellation of the Boeing XB-52 contract. Colonel J. S. Holtoner, Chief of the Aircraft Branch in the office of the DCS/Materiel, was possibly the most vocal about canceling the program as it currently stood:

> "Basically the present conception of the airplane represents little improvement over the B-36C.[122] This version of the XB-52 will result in an airplane of tremendous size, actually approaching 500,000 pounds gross weight. The economics of such size presently appear untenable. In addition, with presently known power plants there is a definite improbability of the ultimate range planned being successful. With the present large advances being made in the aeronautical field there is a definite possibility that this airplane will be obsolete before its completion."[123]

The reasoning of other officials cited new design studies being conducted on unconventional configurations. For example, General Earle Partridge, now Director of Training and Requirements in the office of the DCS/Operations, argued that

> "…preliminary design studies by both RAND and N.A.C.A. [National Advisory Committee for Aeronautics] have indicated that the flying wing type airplane may well be the best suited design for long range bombers of this size. If Northrop is not allowed to compete, we may be shutting ourselves off from consideration of the best bomber design.[124]
>
> "In view of the fact that these new characteristics seem to exploit the potentialities inherent in the flying wing, it is recommended that the contract not be awarded directly to Boeing Aircraft Company but be awarded on open competition of all interested manufacturers."[125]

December 1, 1947 At a conference in General Craigie's office (now Director of Research and Development in the office of the DCS/Materiel in Washington, D.C.), several officials considered the next step for the XB-52. All present agreed that the present configuration of the XB-52 should be cancelled. The speed of the Model 464-17 was too slow to survive enemy interceptors and too expensive for "both industry and the national economy to support the procurement of this airplane in any quantity whatsoever." The conferees discussed the new characteristics and agreed on an airplane with a cruising speed of 500 mph, a range of 8,000 miles with a maximum gross weight of 300,000 pounds. Colonel Warden argued that the range of such an airplane traveling 500 mph was only 7,500 miles and stressed that, when "the curves of propulsive efficiency for gas turbines and turbojet engines" were compared, "turbojet engines appear[ed] to be the more feasible." Warden's argument apparently fell on deaf ears at this time because it was agreed that the "crux of the successful development of this airplane [was] complete and enthusiastic development of [turboprop] engines and a successful propeller."

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[120] Frederick J. Shaw and Timothy Warnock, *The Cold War and Beyond: Chronology of the United States Air Force, 1947-1997* (Washington, D.C.: Air Force History and Museums Program, 1997), p. 2.
[121] MG L. C. Craigie, Dir of R&D, DCS/Materiel, Routing and Record Sheet, Subj: XB-52, 6 Nov 1947, in Bagwell, Sup. Doc. 66.
[122] The B-36C represented a proposal by Convair to equip a B-36 with R-4360 engines fitted with variable discharge turbines (VDTs). Convair claimed that this modification would increase the B-36's speed to 410 mph and its service ceiling to 45,000 feet. Although tempted by the higher speed, the Air Force cancelled the B-36C in August 1947 in order to keep the existing B-36 production order on schedule. Convair reopened the project the following month, recommending retrofitting all B-36As and Bs with the VDT engines without delaying the current contract. Although the Air Force approved the proposal, the VDT program encountered technical difficulties and the proposal was again cancelled in early 1948. Knaack, pp. 15-16, 18-19.
[123] Col J. S. Holtoner to Gen Craigie, Inter-Desk Memorandum: XB-52, 28 Nov 1947, in Bagwell, Sup. Doc. 70.
[124] MG E. E. Partridge, Dir of Training and Requirements, Subj: New Heavy Bomber Contracts, 8 Jan 1948, in Bagwell, Sup. Doc. 81.
[125] Gen Partridge to Dir of R&D, Subj: XB-52, 19 Nov 1947, in Bagwell, Sup. Doc. 68.

The real question, however, was whether to continue the contract with Boeing or to put the new characteristics out for bid. AMC pushed for continuing the contract with Boeing. Warden listed reasons to continue with Boeing: (1) the Air Force would lose approximately one year of development time by awarding a new contract on a competitive basis; (2) the Air Force would lose more than $4 million of research and development funds, as $2.8 million would revert to the Treasury instead of back to the Air Force and an additional $1.5 million had already been spent on the initial design study; and finally, (3) Boeing had proven itself over the years to be the best qualified contractor in the heavy bomber field.

In response to Warden's arguments, the following reasons for competitive bidding were listed: (1) unfavorable public opinion or political repercussions if the current B-52 contract was changed; (2) if Boeing was the best contractor, they easily would win on a competitive basis; (3) Boeing already had the majority of Air Force business, including the B-50, B-47, C-97, L-15, and the GAPA missile; and (4) the delay would be negligible no matter what the decision because, throughout the competition, Boeing would be working on preliminary designs for the desired airplane.[126]

Following the conference, the matter was elevated to the Secretary of the Air Force. Because Air Staff was particularly concerned about the loss of $2.8 million to R&D, it chose to let Secretary Symington make the decision. It forwarded to him its recommendation to circulate the new characteristics to industry.[127]

December 8, 1947 The Air Force Chief of Staff General Carl Spaatz approved the Heavy Bombardment Subcommittee's recommendations of September 1947 and issued new military characteristics for a special-purpose bomber to carry the atomic bomb (see Appendix 4)**.** These characteristics replaced those issued on June 23, 1947.[128]

High speed at tactical operating altitude	500+ mph
Tactical operating altitude	35,000 feet
Range at design gross weight conditions	8,000 statute miles
Average speed for above range	500 mph
Takeoff over 50-foot obstacle at design gross weight condition (with assisted takeoff [ATO] devices)	9,000 feet
Landing over 50-foot obstacle at design gross weight condition less droppable fuel and bombs	9,000 feet
Average bomb load	10,000 pounds

Although the new characteristics reduced the subcommittee's recommended cruising speed from 550 to 500 mph, the possible attainment of higher speeds was emphasized as it had been with the November 1945 and June 1947 characteristics. Additional changes to the requirements included a five-man crew, tail armament only, provisions for aerial refueling, and all-weather, day and night operations.[129]

December 11, 1947 Lieutenant General Howard A. Craig, DCS/Materiel, ordered AMC to cancel Boeing's XB-52 contract and circulate the new characteristics among aircraft manufacturers. Craig's directive also ordered AMC to study the refueling requirement. The Air Force planned to use the B-50 and B-36 bombers as tankers for the B-52 but considered the possibility of acquiring half of its B-52 force as tankers and the other half as bombers. [130]

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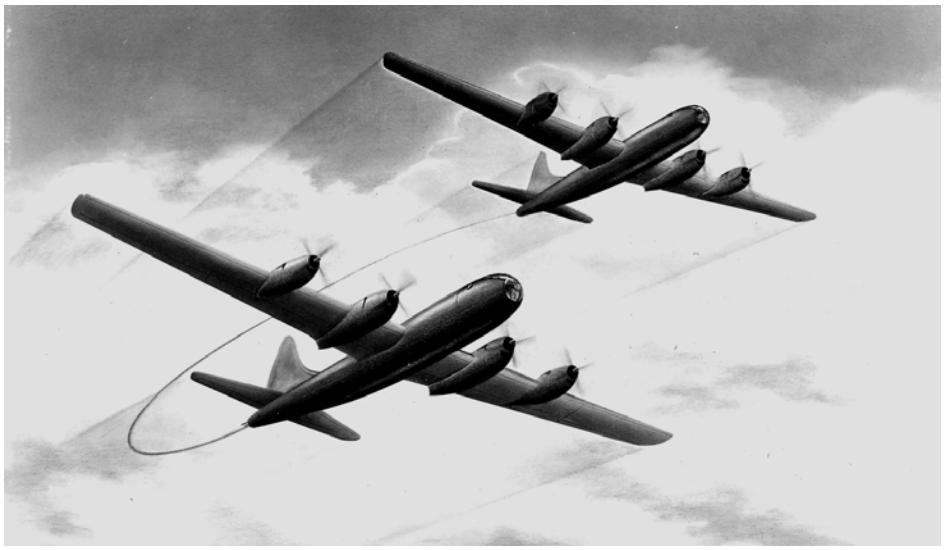
[126] Maj William D. Brady, Chief, Bomber Section, Aircraft Branch, DCS/Materiel, Memorandum for Record: XB-52 Conference, 2 Dec 1947, in Bagwell, Sup. Doc. 74.
[127] Air Staff Summary Sheet with Memorandum for the Secretary of the Air Force, Subj: Heavy Bombardment Aircraft, [1 Dec 1947], in Bagwell, Sup. Doc. 71.
[128] Knaack, pp. 211, 213; Rothman, *Acquisition Milestones,* p. 79.
[129] BG F. H. Smith, Secretary, USAF Aircraft and Weapons Board, to DCS/Materiel, Subj: Military Characteristics for Heavy Bombardment Aircraft, 8 Dec 1947, in Bagwell, Sup. Doc. 74a.
[130] LG H. A. Craig to CG, AMC, Subj: Heavy Bombardment Aircraft, 11 Dec 1947, in Bagwell, Sup. Doc. 75.



Artist's conception of the KB-29M tanker demonstrating the looped hose method of aerial refueling. In 1947, this British development was the only tested method of refueling airplanes in flight.

A KB-29 tanker refuels a B-29 with the Flying Boom equipment developed by Boeing in the late 1940s. This method later became standard on all Air Force bombardment airplanes.

At this time, the British hose method was the only proven aerial refueling technique. The Engineering Division initiated a study—a part of the postwar modification of the Air Corps' aircraft referred to as the GEM (global electronics modification) program—of the British system in late 1947.[131] The aerial refueling program lagged, until General Craigie (then Chief of the Engineering Division) had transferred it from the Aircraft Laboratory to the Bombardment Branch. Warden was sent to England to negotiate a sale of British equipment for testing. He returned with one set and a contract for 34 more.[132] Warden's primary concerns with the hose method were the low rate of fuel transfer (only 200 gallons per minute maximum) and the slow speed of the aircraft during refueling (approximately 200 mph).[133]

Meanwhile, Boeing was developing the Flying Boom, which was subsequently chosen as standard

[131] Thomas A. Julian, "The Origins of Air Refueling in the United States Air Force," in *Technology and the Air Force: A Retrospective Assessment*, ed. Jacob Neufeld, George M. Watson, Jr., and David Chenoweth (Washington, D.C.: Air Force History and Museums Program, 1997), pp. 87-89.
[132] Warden, Interview with Lori Tagg; Warden, Interview with Hugh Ahman; Julian, "Origins of Air Refueling," p. 89.
[133] Warden, Presentation, 28 Feb 1949, pp. 18-19.

equipment on the B-52. Colonel Warden listed the advantages of the boom over the hose method:

> "[A]n operator is not required in the bomber aircraft. Other advantages are its increased rate of transfer capacities and its adaptability to higher speed bombing. The transfer rate expected is in the order of 500 gallons per minute with the use of special high capacity pumps. It has the further advantage of effecting quick connect between the tanker and bomber airplane."

The dry boom, "a completely operable flying boom without fuel transfer equipment," completed flight tests in September 1948.[134]

December 17, 1947 Forty-four years to the day after the Wright brothers' first powered flight, the XB-47 jet bomber made its first flight. The flight test program was regarded as successful. Colonel Warden was particularly impressed with the turbojet engines and the locations of the engines mounted in pods on the wings.[135]

December 26, 1947 Boeing's president, William M. Allen, strongly protested cancellation of their XB-52 contract. Boeing believed that its current design (Model 464-29) could easily be modified to meet the new requirements. Allen stated that their original proposal from 1946 was for an airplane with a tactical radius of 3,100 miles at 400 mph:

> "Based on the development work which Boeing has performed on this project and concurrent engine development, we can definitely modify the present design, and by decreasing the T. R. [tactical radius] to approximately 3,000 miles achieve the new high speed requirements [500 mph].
>
> "…It will be observed that the presently determined requirements of the Air Force much more closely approach the original design proposal that Boeing submitted in April of 1946 than did the stated requirements set forth in the Notice of Competition dated 13 February 1946. If the Air Force was justified in awarding the project to Boeing originally, we are unable to understand why the new requirements should indicate that the project should be thrown open to a new competition….

Nearly a year after the first flight of the XB-47, the Air Force issued a production contract for the medium bomber. The B-47A, of which two are shown here along with the two XB-47s, made its first flight in June 1950. Most of the ten B-47As were used for testing.

[134] *Ibid*., p. 19. Moody, p. 245, states that Boeing received a contract to develop an aerial refueling technique in March 1948.
[135] For more information on the B-47, see Jan Tegler, *B-47 Stratojet: Boeing's Brilliant Bomber* (New York: McGraw Hill, 2000).

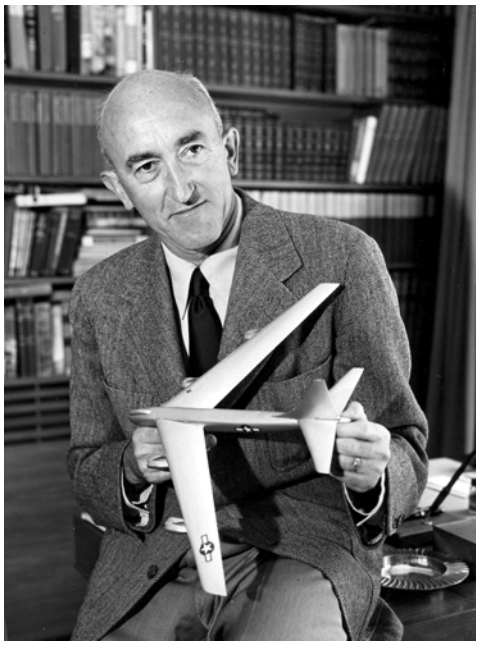
> "…If there were any charge that the Contractor had not performed properly, we could understand the proposed action. However, since this is not the case, and since there are no more than normal variations involved, why should the project again be thrown open thereby giving other companies a second chance to acquire a contract which has rightfully, on the basis of merit, been won by this Company?"[136]

December 30, 1947 AMC's commander, General Joseph McNarney, sent a letter to Air Force Headquarters asking for reconsideration of their decision to reopen the heavy bomber program for competition. McNarney argued that the size of the atomic bomb would not be finalized for at least six months. Throughout 1947, the Atomic Energy Commission (AEC), a civilian organization created in 1946 to manufacture and control atomic weapons, was redesigning the bomb to improve its ballistics. AEC had determined the necessity of redesign after inaccurate test drops of the Fat Man bomb at Bikini Atoll in the Marshall Islands in 1946. The Commission was planning tests of the new bomb (Mark IV) in the spring of 1948.[137] McNarney stressed that the bomb bay size (dependent on the size of the bomb) was a major design parameter of the XB-52:

> "If final size and weight figures are materially different than preliminary figures to be received in January, a major change in acft [s.c., aircraft] design will be [the] result. Continuation of [the] project at Boeing will enable Boeing to make at government expense preliminary studies of [an] airplane carrying different tentative sizes and weights of [the] bomb to be available when these parameters are finally determined."[138]

McNarney also supported Boeing's claim that the new heavy bomber characteristics closely approximated Boeing's initial proposal of April 1946.[139]

December 31, 1947 The Air Force authorized AMC to continue development of the XB-52 with Boeing. Many pros and cons for continuing the contract with Boeing



William Allen, President of Boeing, fought hard to keep the Air Force from canceling the B-52 contract with his company. (*Boeing*)

General Joseph McNarney served as Commanding General of Air Materiel Command from late 1947 to 1949. (*Air Force Materiel Command History Office*)

[136] William M. Allen, Boeing, to Honorable Stuart Symington, Secretary of the Air Force, 26 Dec 1947, in Bagwell, Sup. Doc. 78.
[137] Moody, *Building a Strategic Air Force*, pp. 48, 118, 171.
[138] CG, AMC, to Chief of Staff, USAF, 30 Dec 1947, in Bagwell, Sup. Doc. 79; MG L. C. Craigie, Dir of R&D, DCS/Materiel, Memorandum for the DCS/Materiel, Subj: Development of Heavy Bombardment Aircraft, 13 Feb 1948, in Bagwell, Sup. Doc. 93. LeMay had stated the same viewpoint as early as August 1945: "The design of the bomb and the design of the airplane to carry the bomb probably will be closely related as long as the bomb remains heavy and awkward." Quoted in Moody, *Building a Strategic Air Force*, p. 56.
[139] CG, AMC, to Chief of Staff, USAF, 30 Dec 1947, in Bagwell, Sup. Doc. 79; MG L. C. Craigie, Dir of R&D, DCS/Materiel, Memorandum for the DCS/Materiel, Subj: Development of Heavy Bombardment Aircraft, 13 Feb 1948, in Bagwell, Sup. Doc. 93.

had been argued, but Allen's and McNarney's arguments seemed to have had great weight in Secretary Symington's decision.[140]

1948

January 7, 1948 Design requirements for the new XB-52 were released to Boeing, indicating that the Air Force would continue the contract instead of opening it for competition. It was stressed, however, that the Air Force had not upheld the contract because it would have been a "breach of faith" to cancel it, as stated by Boeing. Instead, the "decision in favor of Boeing was made because of our ability to use funds already obligated on the XB-52 contract and the appreciable saving in time which would be made by this procedure."[141]

January 9, 1948 The Armament Laboratory registered its opposition to tail-only armament as listed in the newest military characteristics for the heavy bomber. It cited three studies conducted in 1947 by Boeing, Sperry Gyroscope Company, and Glenn L. Martin Turret Division, all of which found that

> "…all around defensive armament must be provided for the B-52 if it is required to defend itself against fighter or interceptor aircraft. …The advent of higher speeds changes only the effectiveness of the fixed gun fighter attack from directions other than the nose and tail. Fighters with fixed offset guns or turrets will make attacks from virtually any direction possible. …The fact that the requirements have been relaxed to allow tail armament only will spur any potential enemy to immediate and rapid development of this type of offensive fighters."

The Armament Laboratory considered the development of a 220-degree tail turret suitable for the XB-52 an "extremely difficult job," and estimated that development would take up to five years and $3 million. It further intimated, "As a matter of information it is observed that the Air Materiel Command has been unable to date to develop a turret to fire accurately through a 220° arc." The only such turret then under development was for installation in the nose of XP-87 and XP-89 fighters. The Laboratory recommended the interim use of proven armament in the XB-52, such as the upper and lower deck configuration used in the B-50, which could later be replaced by the required 220-degree-arc gun.[142]

January 15, 1948 Despite the decision a week earlier to continue the contract with Boeing, the Air Force again discussed cancellation of the XB-52, this time based on flight test reports for the YB-49, a turbojet-powered version of Northrop's piston-engine XB-35 flying wing. "Concern was evidenced that the USAF [U.S. Air Force] might not receive the best possible aircraft unless the flying wing was considered."[143]

In retrospect, this concern seems misplaced. The YB-49 made a 34-minute first flight on October 21, 1947. Although it showed some promising characteristics, including speeds in excess of 400 mph at 35,000 feet, later flight tests illuminated a number of stability problems that made it a questionable bombing

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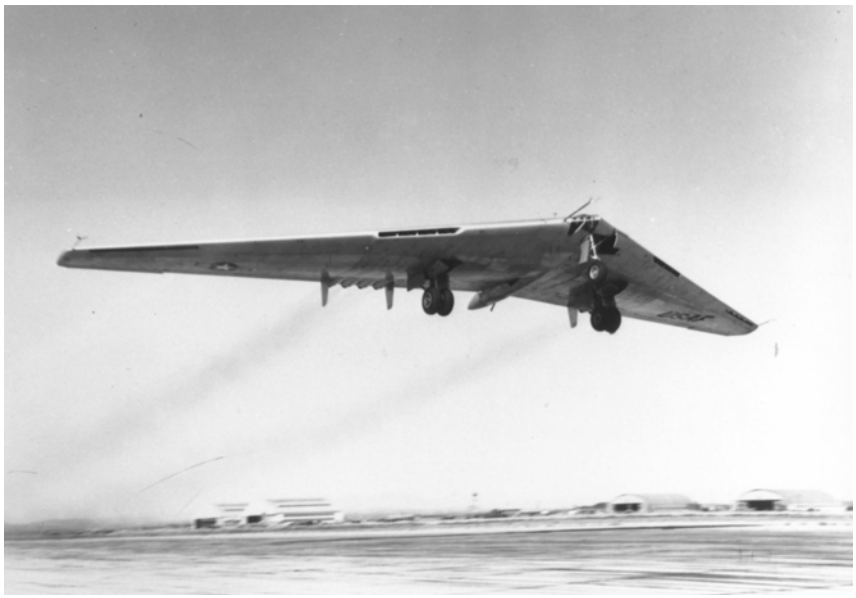
[140] *Ibid*.
[141] BG Donald L. Putt, Deputy Chief, Engineering Division, Routing and Record Sheet: Extracts from Daily Activity Reports of HQ, USAF, 14 Jan 1948, in Bagwell, Sup. Doc. 83; D. L. Putt to Chief of Staff, U.S. Air Force, Subj: Heavy Bombardment Aircraft, 26 Jan 1948, in Bagwell, Sup. Doc. 87.
[142] Capt A. L. Thayer, Armament Laboratory, Memorandum Report on XB-52 Defensive Armament, 9 Jan 1948, in Greene, Sup. Doc. 3; BG William M. Morgan, Chief, Engineering Operations, Engineering Division, to Chief of Staff, USAF, Subj: Fire Control System for the Revised XB-52 Heavy Bomber, 12 Mar 1948, in Bagwell, Sup. Doc. 108.
[143] LG H. A. Craig, DCS/Materiel, Memorandum to Dir of R&D, Subj: XB-52 Development, 15 Jan 1948, in Bagwell, Sup. Doc. 84.

platform.[144] Colonel Warden, who had been Chief of the XB-35 program prior to taking over the Bombardment Branch, commented on the fact that the flying wing's bombing accuracy was affected by the fact that it "didn't care whether it was crabbing or going straight."[145] Still, many in Air Staff were convinced that the flying wing had benefits over the conventional design of the XB-52 and these needed to be carefully studied before a final decision was made on the heavy bomber configuration.



Northrop's jet-propelled flying wing, designated the YB-49, made its first flight in October 1947. The Air Force contracted for the production of 30 RB-49 reconnaissance versions in August 1948, but by the end of the year, the contract had been cancelled. The entire B-49 program was cancelled in March 1950.

January 16, 1948 Boeing proposed to conduct Phase I design studies for their Model 464-35 of the XB-52 at a cost of $563,700.[146] The Model 464-35 had a gross weight of 280,000 pounds and was powered by four T35-3 turboprop engines. According to a Boeing history of the B-52, once the Heavy Bombardment Subcommittee recommended the use of aerial refueling to meet range requirements,

> "…it then became possible to design an airplane with high speed and cruising speed comparable to that desired in the medium bomber class at a gross weight only slightly higher than the medium bomber and considerably less than previous proposed versions of the XB-52."[147]

January 26, 1948 Secretary Symington again stopped Boeing's development of the XB-52. He vaguely referred to a "possible future divergence from the then existing plan" and stressed that the January 7 directive "was not firm." AMC was ordered "to discontinue any further discussions or negotiations with the Boeing Company on this development."[148] This "future divergence" was based upon the most recent information on flying wings. A flurry of support for the conventional wing over flying wings followed. Boeing's response was that "there is general agreement among aeronautical engineers that certain disadvantages, such as marginal stability and control, particularly as speeds are increased above those attained in present production aircraft, are inherent in the all-wing design." Boeing's President, William Allen, argued:

> "We believe that research on the all-wing type should be encouraged…for the purpose of eliminating, if possible, the inherent deficiencies of this type. However, we strongly recommend

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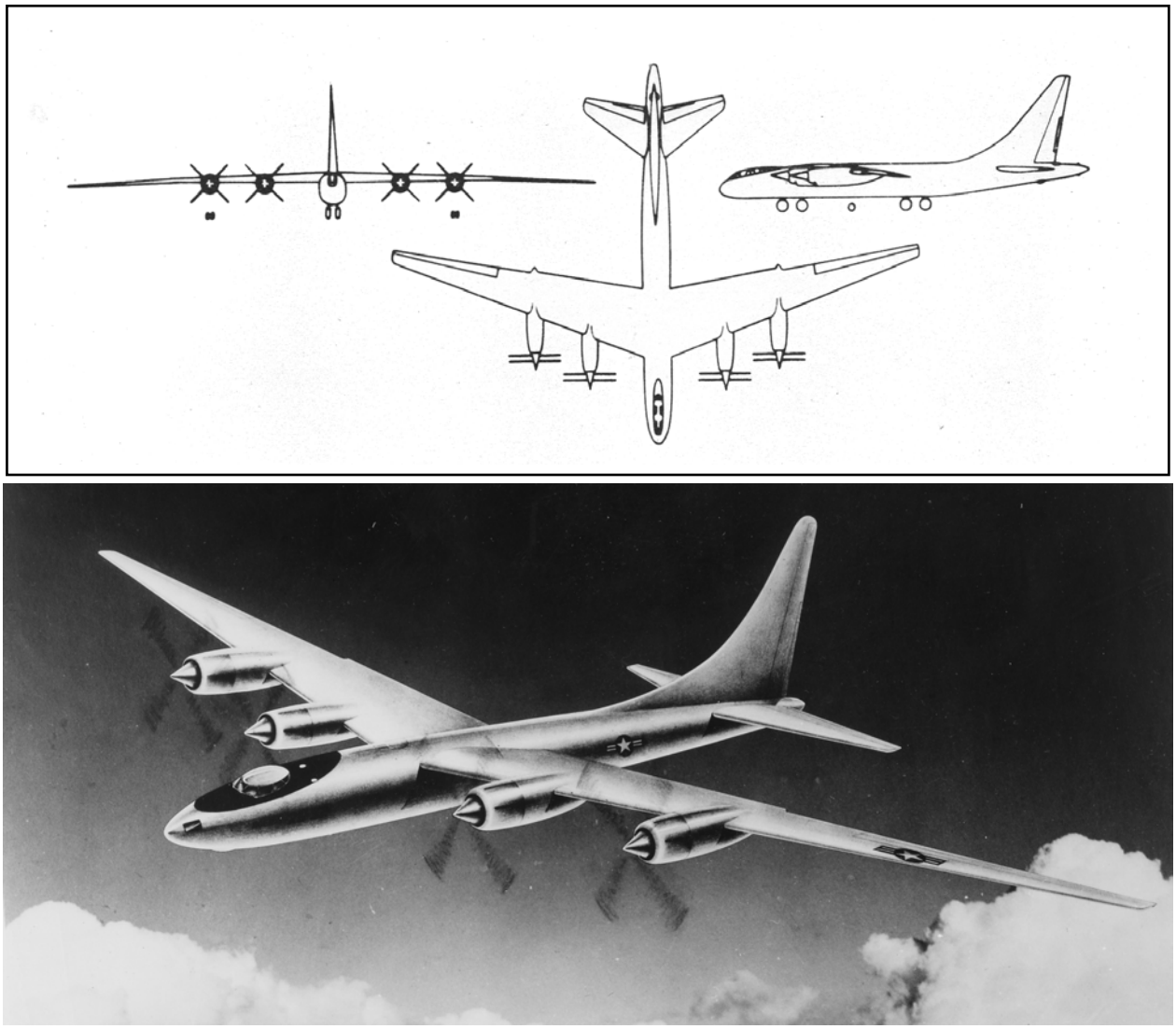
[144] Richard P. Hallion, "Before B-2: Part Two: The History of the Flying Wing Since 1945," *Air Power History* 41 (4) Winter 1994, pp. 40-51.
[145] Warden, Interview with Lori Tagg.
[146] Boeing Aircraft Company to CG, AMC, Subj: Contract W33-038 ac-15065, Model XB-52 Airplane, 16 Jan 1948, in Bagwell, Sup. Doc. 86.
[147] Boeing, p. 24; MG L. C. Craigie, Dir of R&D, DCS/Materiel, to CG, AMC, 30 Jun 1948, in Bagwell, Sup. Doc. 131.
[148] Craigie, Memorandum to DCS/Materiel, 13 Feb 1948, in Bagwell, Sup. Doc. 93.



Three-view diagram and artist's conception of Boeing's Model 464-35 proposed in January 1948. This was the first XB-52 model that featured a swept-back wing.

> against the exclusive development of this type in the heavy bombardment field, since failure to solve the basic problem of obtaining suitable high-speed control and stability characteristics in a reasonable time would leave us without an effective heavy bombardment airplane. The performance of a conventional type can be shown to be substantially equivalent to that of the all-wing type…. This being the case, and since the conventional type of aircraft as proposed by this company is a well-balanced design and not marginal in any respect, we sincerely believe that first priority should be given to the development of aircraft such as the XB-52."[149]

Brigadier General Donald L. Putt, acting Assistant DCS/Materiel, supported Boeing's arguments. He believed that the primary question before Air Staff was "[w]hen must we have a long range bomber in combat service?" Development of the flying wing, or any other unconventional configuration might have been the

[149] William M. Allen to Stuart Symington, 6 Feb 1948, in Bagwell, Sup. Doc. 88.

best route to take if the time element was not critical, because "the new design cannot possibly be delivered at the same time as that scheduled for the first design." If the time element was critical, as had been stated in 1946, then the present XB-52 program needed to continue.[150]

Major General Franklin O. Carroll, Director of Research and Development, Engineering Division, in Air Materiel Command, supported Boeing's contentions that the conventional aircraft was the best design for a heavy bombardment airplane. He stressed that the flying wing did not have the space to carry the military stores required of medium and heavy bombers. When modifications were made to the flying wing design to enable it to carry the required bombs (i.e., adding a nacelle or body), the airplane was no longer a flying wing and therefore lost its advantages over conventional configurations. "In that it is apparent that no marked superiority exists in going to a wing-type airplane, it is considered good business to continue with the design which has the fewest unsolved problems." General Carroll stated that much more time was required to find solutions to the flying wing's stability and control problems, as well as its lack of versatility in accommodating the various shapes and weights of required military loads. He concluded:

Franklin O. Carroll, shown here as a brigadier general, served in numerous positions at Wright Field beginning in 1927, including Chief of the Experimental Engineering Section's Research and Development Branch and Assistant to the Deputy Commanding General for engineering at the Air Materiel Command headquarters. In mid-1947, he became the Deputy Chief of the Research and Engineering Division in the Office of the Assistant Chief of Air Staff for Materiel. On his promotion to major general, in October 1947, he became Director of Research and Development at Air Materiel Command, before heading back to the Pentagon as Assistant Deputy Chief of Staff for Materiel in October 1949.

Donald L. Putt, shown here as a major general, spent several tours at Wright Field between 1933 and 1948. He was a test pilot, an engineer in the Materiel Division's Aircraft Project Group, Assistant Chief of Staff for Intelligence at Air Technical Service Command headquarters, and Deputy Chief of the Engineering Division. In 1948, Putt became Director of Research and Development in the Office of the Deputy Chief of Materiel, U.S. Air Force. Putt later served as Assistant Deputy Chief of Staff for Development, Vice Commander of Air Research and Development Command, and Deputy Chief of Staff for Development.

[150] D. L. Putt, Memorandum for Gen Craig, Subj: XB-52 Problem, 10 Feb 1948, in Bagwell, Sup. Doc. 90.

> "In consideration of the factors and in view of the strategic planning which will be predicated on this country's having heavy bombers meeting the current military characteristics at a given time, it is strongly recommended by the Air Materiel Command that the course of action be followed which will offer the best possibilities of solving the engineering problems associated with this development within the given time period."[151]

The issue became moot later in the year, when the second prototype YB-49 crashed. Although flight tests of the YRB-49 continued into mid-1950, the XB-52 never again faced competition from the flying wing. The B-35/B-49 flying wing program was cancelled in 1949 due to stability problems.[152]

January 30, 1948 A mockup inspection of the Model 464-17 was held at Boeing's plant in Seattle. Although the characteristics had been changed and progress was ongoing on the Model 464-35,

> "…the inspection was conducted on the previous configuration in the interest of salvaging as much as possible of the work already accomplished and with the purpose of enabling detail requirements to be injected into the new configuration so as to effect [*sic*] a time savings later in the program."[153]

The mockup included one wood fuselage, the empennage, the right half of the wing, and nose mockups of four crew arrangements. Three of the cockpit arrangements were selected for further study, and a later conference was proposed for making a final decision on the layout of the cockpit.[154]

February 12, 1948 SAC stated its views on crew seating arrangements in strategic bombers. SAC favored the tandem arrangement, in which the copilot sat behind the pilot, over a side-by-side arrangement because the former allowed for ejection systems for individual crewmembers and contributed to the aerodynamic shape of the fuselage.[155]

February 14, 1948 The Air Force made the final decision not to reopen the XB-52 competition. Furthermore, in a cable to the commanding general of AMC, Undersecretary of the Air Force Arthur Barrows "voiced the opinion that this program should be pushed vigorously."[156]

March 1, 1948 Boeing's contract was changed to cover preliminary engineering, wind tunnel testing, data, and a mockup of Model 464-35.[157]

March 3, 1948 The Air Force again revised the military characteristics for its heavy bombardment aircraft (see Appendix 5). These revisions included:

High speed, tactical operating altitude	550+ mph desired, 500+ mph required
Tactical operating altitude	45,000 feet desired, 40,000 feet required
Service ceiling ½ engines	20,000 feet

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[151] MG F. O. Carroll, Dir, R&D, Engineering Division, to Chief of Staff, USAF, Subj: Heavy Bombardment Configuration, 13 Feb 1948, in Bagwell, Sup. Doc. 92.
[152] Northrop learned much from the XB-35/YB-49 program, and later put that knowledge to work in the United States' first production flying wing aircraft, the B-2 Spirit, in the 1980s and 1990s. Hallion, pp. 42, 47.
[153] Maj F. L. Thomas, Subj: Mock-up Inspection of Boeing Airplane Company—XB-52 Airplane, 8 Mar 1948, in Bagwell, Sup. Doc. 102; Boeing, pp. 4, 19.
[154] MG Alden R. Crawford, Chief, Engineering Division, to Chief of Staff, USAF, Subj: Crew Arrangements and Crew Responsibilities, 27 Feb 1948, in Bagwell, Sup. Doc. 98.
[155] Col C. S. Irvine, Assistant to the Chief of Staff, HQ, SAC, to CG, 15th Air Force, Subj: Crew Arrangement on Advanced Types of Strategic Bombers, 12 Feb 1948, in Bagwell, Sup. Doc. 91.
[156] Memo from HQ, USAF, to CG, AMC, [18 Feb 1948], in Bagwell, Sup. Doc. 95.
[157] Boeing, p. 10.

Range at design gross weight	10,925 stat. mi. (9,500 n.mi.) 4,600 stat. miles (4,000 n.mi.) radius
High cruising speed	550 mph desired, 500 mph required
Takeoff over 50-foot obstacle (without ATO)	6,500 feet desired, 9,000 feet required
Landing over 50-foot obstacle	6,500 feet desired, 9,000 feet required
Average bomb load	15,000 pounds

The 15,000-pound bomb load represented a more flexible estimate of the size of the atomic bomb. The requirements also stated that defensive firepower would be provided by a tail gun with a 220-degree arc of fire from wing tip to wing tip. Armor was deleted, except around the engines, and the crew number increased to six men (pilot, copilot, bombardier-navigator, weaponeer, engineer, and gunner). These characteristics also called for provisions for reconnaissance equipment.[158]

March 18, 1948 At a conference held at AMC headquarters, the Air Force chose the tandem seating arrangement for the cockpit of the XB-52.[159] It was believed that tandem seating for the pilot and copilot provided better vision and contributed to increased speed potential for the aircraft. It was further decided that the bombardier, navigator, and weaponeer would be stationed side by side in the aft section to provide for co-use of the equipment. The last decision reached at the conference included deletion of the flight engineer with the responsibilities given to the copilot.[160]

April 7, 1948 The change order for Phase I development of Boeing's Model 464-35 was approved.[161]

April 20, 1948 Boeing issued a proposal for the complete Phase II development of Model 464-35, including the construction, flight test, and delivery of two airplanes, for $28.3 million, of which $1.8 million was fixed fee.[162]

April 28, 1948 AMC sent Boeing the proposed equipment list and requirements for the reconnaissance version of the aircraft as described in the requirements of March 3, 1948. For the reconnaissance version, the crew was to include a pilot, copilot, two photo-radar navigators, two photographers, and four RCM (radar countermeasures) operators. The photographic equipment included seven K-40 cameras. AMC stated, "It would be highly desirable to have the K-40 camera and bombs interchangeable," so the cameras could be removed for night bombing missions.[163]

May 1948 Colonel Warden asked Boeing to consider a design of the XB-52 using Westinghouse XJ40 jet engines. According to Boeing's B-52 history:

> "During the development of the Model 464-35, it became apparent that deliveries of the engine and propeller could not be expected to keep pace with airframe developments. Serious engine

[158] Col George F. Smith, Chief, Aircraft Projects Section, Engineering Division, to Chief of Staff, USAF, Subj: XB-52 Configuration, 19 Jul 1948, in Bagwell, Sup. Doc. 134; Col Leslie O. Peterson, Chief, Requirements Division, Directorate of Training and Requirements, to DCS/Materiel, Subj: Military Characteristics for Heavy Bombardment Aircraft, 3 Mar 1948, in Bagwell, Sup. Doc. 100; BG Donald L. Putt, Deputy Chief, Engineering Division, to Chief of Staff, USAF, Subj: Heavy Bombardment Aircraft, 26 Jan 1948, in Bagwell, Sup. Doc. 87.
[159] Boeing, pp. 4, 48.
[160] G. W. Bollinger, Project Engineer, Bombardment Branch, Memorandum Report on Conference on Crew Arrangement, XB-52 Airplane, 16 Apr 1948, in Bagwell, Sup. Doc. 118.
[161] Bagwell, p. 10.
[162] Boeing, p. 10; William M. Allen, Pres., Boeing, to CG, AMC, 20 Apr 1948, in Bagwell, Sup. Doc. 119.
[163] Col George F. Smith, Chief, Aircraft Projects Section, Engineering Division, to Boeing, Subj: Strategic Reconnaissance Version of XB-52, 28 Apr 1948, in Bagwell, Sup. Doc. 121.

> propeller difficulties also came to light including: (1) the engine control problem; (2) the propeller design; and (3) the engine spline shaft strength. As these problems were investigated in more detail by the airframe, propeller and engine manufacturers, and Air Materiel Command it became obvious that an extended development program was required before such a design would become operational.
>
> "The Air Materiel Command could, therefore, not safely proceed on a production program with any reasonable degree of assurance of a reliable propeller driven aircraft. Delays of at least four years were indicated in conferences with propeller and engine manufacturers held during May, 1948. In addition, a general dislike of propellers and a preference for jets was [*sic*] repeatedly indicated by nearly all Air Force representatives."[164]

Warden's request, which was forwarded in writing on June 15, 1948, included determining the feasibility of range extension through overweight refueling of both the turboprop and turbojet airplanes. His choice of the J40 engine to power his big bomber is not surprising, given the state of turbojet development in the United States at the time. Westinghouse began studying turbojet propulsion in 1941, and the Navy soon contracted with the corporation to build the 19A, a small booster turbojet. Only 16 months later, the engine underwent bench tests and, soon thereafter, it flew under a F4U Corsair, making it the first American-built axial-flow turbojet engine in flight. In mid-1947, the Navy's Bureau of Aeronautics initiated development of the J40 with Westinghouse.[165] With 6,000 pounds thrust, it was the most powerful turbojet in 1948 and was being designed by the company with the longest history of turbojet development in the United States. General Electric, which began studying turbojet designs in 1943, was close behind Westinghouse with the development of its J47 turbojet with a normal thrust rating of 4,900 pounds.[166]

June 1948 AMC's Procurement Division reported that Phase I of the XB-52 was nearing completion at a total cost of $2,348,962.[167]

June 24, 1948 The United States Air Force began an airlift to counter the Soviet's blockade of the city of Berlin. In more than 270,000 missions, the Air Force delivered 2.3 million tons of supplies to Germany. The Soviets lifted the blockade in May 1949. The Berlin Airlift, the first obvious post-World War II example of the Soviet Union's intent to expand its sphere of influence, illustrated how far the United States was willing to go to preserve democracy around the world. The possibility of future, perhaps more lethal, challenges provided support for increased military strength, particularly for strategic, long-range, high-speed aircraft like the B-52. At the time of the Berlin Airlift, only one unit in SAC was equipped for the delivery of the atomic bomb.[168]

June 26, 1948 Convair's B-36A Peacemaker entered service with the 7th Bomb Wing at Carswell Air Force Base, Texas. These early B-36s were used only for training purposes.[169]

July 1948 In response to Colonel Warden's request for studies on a turbojet-powered B-52, Boeing submitted a preliminary study of Model 464-40.[170] Boeing indicated that its 280,000-pound Model 464-40 with eight J40 jet engines would have higher speed (536 vs. 500 mph) and

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[164] Boeing, pp. 30-31.
[165] St. Peter, pp. 131-132, 138.
[166] St. Peter, pp.152-154; Squire Brown, Personal Communication with Lori S. Tagg, March 2003. In November 1949, the second XB-47 bomber, powered by six 5,200-pound-thrust J47 engines, made its first flight. All production B-47 aircraft were equipped with J47 engines. Knaack, pp. 105, 156.
[167] Bagwell, p. 10.
[168] See Roger G. Miller, "Freedom's Eagles: The Berlin Airlift, 1948-1949," *Air Power History* 45 (3) Fall 1998, pp. 4-39; Moody, *Building a Strategic Air Force*, p. 188, 215.
[169] Knaack, p. 21.
[170] *Ibid*., pp. 215-216.

altitude performance (45,200 vs. 42,000 feet) over the Model 464-35, but it would also have a reduced range (6,750 vs. 8,000 miles). The same trends applied to the refueled versions of the turboprop and turbojet versions. A. G. "Art" Carlsen, Boeing's chief project engineer, stated:

> "[T]he resulting reduction in range appears quite reasonable in view of the higher performance available in climb, ceiling, and cruising and maximum speeds. Takeoff distances are somewhat extended and ATO installations which were not needed because of the exceptional takeoff performance of the 464-35 airplane may be considered desirable on the jet airplane. …The Model 464-40 basic jet airplane therefore appears to be a desirable tactical airplane, combining excellent speed-range characteristics."[171]

According to Boeing, "The basic philosophy was to make as few changes as possible to the overall configuration [of the Model 464-35], thereby obtaining a flyable prototype of the 464-35 in as short a time as possible. Although no contracts were let on Model 464-40, studies were encouraging and considerable interest was exhibited by the Air Force in this model."[172]

July 1, 1948 **Boeing received a contract to develop the XB-55, slated as successor to the B-47 medium bomber, as well as the B-29s and B-50s still in service.**[173] Design requirements were submitted to industry in October 1947 for an airplane with a 2,000-mile radius, a 10,000-pound bomb load, and a gross weight less than 200,000 pounds. The airplane submitted by Boeing was based around the Allison T40 turboprop engine. The original requirement for all-around defensive armament was relaxed to allow for nose and tail armament only, a factor that reduced the weight of the airplane to allow it to meet the range requirement. Over the next year, the airplane evolved into a turbojet configuration, and investigations were even conducted on a delta-wing configuration. The XB-55 did not withstand budget crunches of the late 1940s and was cancelled in 1949[174] (see January 1949).

October 1948 **The Air Force approved the design of the 10-engine, jet-assisted B-36D.** In addition to the aircraft's six R-4360 piston engines, the new model B-36 included two pairs of General Electric J47 jet engines in pods below the wings. The prototype B-36D, a converted B-36B, made its first flight in March 1949. Never a serious competitor of the B-52, the B-36D had a 33,100-foot service ceiling, a top speed of 353 mph, and a combat radius of just over 3,400 statute miles.[175]

The B-36D had six piston engines augmented with four J47 turbojets. The first D version became operational with SAC in 1950, and 26 were built. In addition, 64 B-36Bs were eventually converted to the B-36D configuration.

October 14, 1948 **Military characteristics, approved in August, were issued for the development of the XR-16, a dedicated strategic**

[171] Carlsen to CG, AMC, 28 Jul 1948, in Bagwell, Sup. Doc. 135; Greene, p. 9.
[172] Boeing, p. 31.
[173] Boyne, *Boeing B-52*, p. 49.
[174] Warden, Presentation, 28 Feb 1949.
[175] Knaack, pp. 31, 54-55.

reconnaissance airplane "encompassing photographic, electronic and weather reconnaissance."[176] The AAF began consideration of the development of a dedicated strategic reconnaissance aircraft following World War II. In fact, in late 1947 and early 1948, development of such an aircraft was considered a higher priority than that of a new medium bomber. In August 1947, the Aircraft and Weapons Board recommended procurement of the Republic F-12 and development of a new strategic reconnaissance aircraft, but by late spring 1948, the variable discharge turbine (VDT) engines slated for the F-12 (as well as later models of the B-36) had been cancelled. In place of the F-12, the Air Force considered giving a contract to Northrop for the RB-49, a reconnaissance version of the jet-powered flying wing aircraft. This plan was also scrapped.[177] The fate of the strategic reconnaissance aircraft remained in flux throughout 1948. By early 1949, the Air Force dropped the program, which apparently never proceeded past the requirement stage, in favor of bomber aircraft that could pull double duty as reconnaissance platforms[178] (see April 5, 1949).

October 16, 1948 General Craig, DCS/Materiel, expressed his thoughts on the growth potential of the B-52. Craig did not believe the aircraft would be able to grow "through a series of models similar to that of the B-29." Instead, he felt that

> "…large improvement in this class of aircraft will come with radical developments which will require completely new airframe developments. It is also believed that unless supersonic propellers become a reality, future aircraft of this class will be powered by turbo-jet engines. However, neither of these developments are sufficiently near at hand that the turbo-prop step can be eliminated."

Craig concluded, "[A]n urgent requirement exists for the B-52 in its present configuration [turboprop] to insure against the eventuality that foreign bases from which shorter range aircraft can operate are denied to us."[179]

October 21, 1948 Three Boeing officials arrived at Wright Field to discuss the turboprop model (464-35) of the XB-52. The Boeing representatives included Art Carlsen, the project engineer; Vaughn Blumenthal, aerodynamicist; and George Schairer, Chief of Aerodynamics. Colonel Warden told the three men that the B-52 was not a significant enough improvement over the B-36 for the Air Force to justify further development.[180] Additionally, Warden considered the problems with the propeller-engine combination "insurmountable," and neither the propeller company nor the engine company would take responsibility.[181] Upon further intimation that the jet-powered B-47 had everything the Air Force needed except range—the B-47 had an approximate range of only 4,500 miles—Warden requested a preliminary study of an entirely new airplane powered by Pratt & Whitney's JT3 turbojet (designated the J57 in January 1949).[182]

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[176] Memorandum, Subj: B-52A and XRB-52 Mockup Military Characteristics dated 3 Oct 48 established characteristics for a Strategic Reconnaissance Aircraft, Appendix VII-1cc to Weapons Systems Division, Memorandum Report on Conference on RB-52 Airplane Configuration and Equipment Requirements, 20 Sep 1951, in Greene, Sup. Doc. 73; Art Boykin, "Reconnaissance Aircraft Characteristics and Limitations," Presentation to Reconnaissance Committee, 28 Sep 1950, in Box 3055: Aircraft/Bomber, Box 2, on file in ASC/HO Archive. Military Characteristics for the Strategic Reconnaissance Aircraft are included in the Summary Minutes of the First Meeting of the USAF Aircraft and Weapons Board, 19, 20, 21, 22 Aug 1947, Inclosure 7, and the Summary Minutes of the Second Meeting of the USAF Aircraft and Weapons Board, 27, 28, 29, 30 Jan 1948, Inclosure 4, both in Box 2030, ASC/HO Archive.

[177] Moody, *Building a Strategic Air Force*, pp. 185-186, 239-240

[178] Knaack, p. 220n; Boykin, "Reconnaissance Aircraft Characteristics and Limitations."

[179] LG H. A. Craig, Deputy Chief, Memorandum for Gen Lauris Norstad, DCS/Operations, Subj: XB-52 Long Range Bombardment Airplane, 16 Oct 1948, in Bagwell, Sup. Doc. 138.

[180] Brown, *Flying Blind,* p. 140.

[181] Bob Withington, Presentation given at MIT, n.d., Video Recording, on file at ASC/HO; *Gathering of Eagles*, Video Recording.

[182] Greene, pp. 9-10. According to Bob Withington, Colonel Warden "challenged" them to save the B-52 from cancellation. "He didn't tell us what to do, but we knew." Withington, Presentation at MIT, Video Recording.

October 22, 1948 The Boeing representatives retired to their hotel room to ponder AMC's request for the jet-powered B-52. They were joined by Ed Wells, Vice President of Engineering; Bob Withington; and Maynard Pennell, the latter two of whom were in town for the XB-55 development program. Wells flew in from Seattle specifically to help on the new XB-52 design. George Schairer commented 30 years later, "It is certainly a sad exercise when you're working on something the customer doesn't want to buy. So we were in a desperate effort to save our contract, change it into something the customer wanted to buy and go forward."[183]

Over the weekend, these six men refined the XB-52 into Model 464-49, which drew heavily on other Boeing designs. From the B-47 design, the engineers adopted the swept wing. The XB-52 Model 464-35 already had 20 degrees of sweep, but the Boeing engineers increased the sweep to 35 degrees. Boeing experimented with swept wings in their wind tunnel, which had been built in 1941. Following George Schairer's trip to Europe with Theodore von Karman in 1945, Boeing engineers conducted a number of tests that corroborated German research data on the swept wing, as well as the work of Robert T. Jones at NACA. Using this data, Boeing was able to apply the swept wing to the B-47 with dramatic results.[184] Boeing also adopted the podded engines first used on the B-47 to the new XB-52 design.

Interestingly, the B-47 and B-52 have always been considered as a continuum. In fact, the B-52 had as much to gain from Boeing's XB-55 design. In 1996, Colonel Warden stated, "We had the flexibility of doing these things and doing a lot of them simultaneously. …The aircraft developments were close enough so that we could benefit from one to the other."[185] The Boeing engineers recalled that they basically doubled the XB-55 to design the B-52—doubled the wing area and doubled the engines.[186] Also from the XB-55, the Boeing engineers adopted wings of variable ratio thickness, as opposed to the constant thickness on the B-47 wings. The new wing was thick at the root and tapered out to a thinner wing tip. Boeing called this their "second generation swept wing."[187] It provided the B-52 with an appreciable weight savings while increasing its critical mach number, and allowing for more fuel storage in the wing.

Boeing had completed much of the research for converting the turboprop design to a turbojet after Warden asked for a study on mating Westinghouse J40 turbojet engines with the B-52 earlier in the year. Why, in October, Warden chose the JT3 (J57) engines for the B-52, as well as a company with little turbojet experience, instead of continuing with Westinghouse and the J40 is unknown. According to one of historian James St. Peter's sources, AMC and Pratt & Whitney had always planned to convert the XT45 turboprop to a turbojet design, even developing the engine for easy conversion at the outset. St. Peter claimed this manipulation was meant to hide any duplication of effort related to the Navy's development of the J40 in order to get the T45 program cleared in Congress.[188] Warden disagreed, stressing that Pratt & Whitney, at the time the XT45 contract began, was still reluctant to see any useful application of the turbojet and believed the future of propulsion lay in the turboprop.[189] This is corroborated in the memoirs of Ernest "Cliff" Simpson, Chief of the Turbine Engine Division of the Aero Propulsion Laboratory at Wright Field.[190]

Once Pratt & Whitney jumped on the turbojet bandwagon, however, the company realized that "to get back into the race we [had to] 'leap-frog' them [its competitors]—come up with something far in advance of what they were thinking about." [191] That "something" was the dual-spool, axial compression on the

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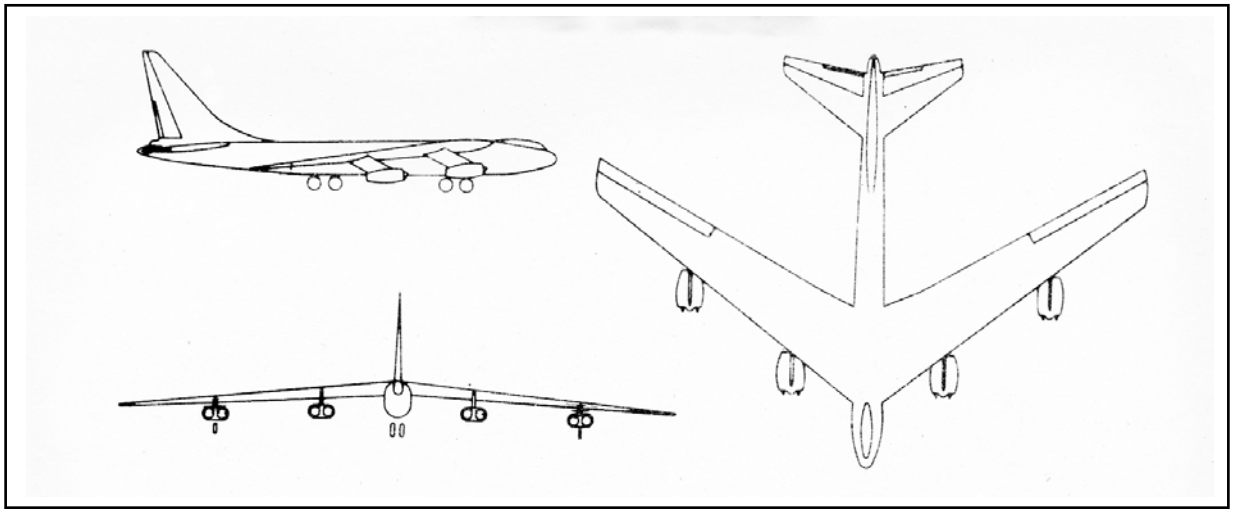
[183] *Launching the B-52*, Video Recording.
[184] *Ibid*. In the video, Schairer comments that German research predated Jones' by nearly 10 years, but that the Jones' studies were what initially influenced Boeing's experiments. The German data helped them accelerate their studies on swept wings, allowing them to apply it to the B-47 in time to beat the airplane's competitors (the B-45, B-46, and B-48).
[185] *Gathering of Eagles*, Video Recording.
[186] *Launching the B-52*, Video Recording; Mary Wells Geer, *Boeing's Ed Wells*, (Seattle: University of Washington Press, 1992), p. 118-119.
[187] Withington, Presentation at MIT, Video Recording.
[188] St. Peter, pp. 174-175. St. Peter's source for this information was Richard Coar, retired executive vice president at United Technologies Corporation and one of the engineers on Pratt & Whitney's J42 and J48 engine programs.
[189] Warden, Telephone Conversation with Lori Tagg, 11 Feb 2003.
[190] *The Memoirs of Ernest C. Simpson, Aero Propulsion Pioneer*, ed. by James St. Peter (WPAFB: ASD and AFWAL, 1987), p. 40.
[191] Quoted in St. Peter, p. 173.

XT45/JT3, from which Pratt & Whitney promised 8,700 pounds of thrust at takeoff with lower specific fuel consumption than the J40.[192]

In retrospect, Warden's directive to go with the JT3 (J57) proved to be the proper course of action. In 1948, development of the J40 was on-track and shortly thereafter, Westinghouse increased the target thrust of the engine from 6,000 to 10,000 pounds. The Navy planned to use the J40 on several of its aircraft, including the Douglas A3D attack airplane, but by 1952, Westinghouse reported difficulties meeting the target thrust. The following year, the Navy cancelled the contract on the underpowered J40s in favor of using the J57 or Allison J71 turbojets.



Three-view diagram and artist's conception of Boeing's Model 464-49, the swept-wing turbojet-powered bomber proposed in October 1948

[192] St. Peter, p. 175.

With new wings and new engines, Boeing estimated the range of its new 330,000-pound airplane at 8,000 miles, with a cruising speed of 520 mph at 49,000 feet altitude, and a top speed of 572 mph.

October 25, 1948 The Boeing representatives returned to Wright Field and presented their proposal for Model 464-49. Without conferring with his superiors, Colonel Warden authorized Boeing to begin work on the new design in lieu of the 464-35. A year later, Colonel Warden stated:

> "Considering the complexities of the power plant problems associated with turbo-prop engines, propellers and controls, and also the additional performance that could be attained, a new design was proposed based on the use of jet engines. Within the same time period it appeared possible to materially increase the bombing altitude and cruising speeds and still meet the range required by the Military Characteristics. This new design proposal increased the bombing altitude over 12,000 feet and at the same time increased the combat zone cruising [speed] from 500 (434 Kn.) miles per hour to 527 (457 Kn.) miles per hour. It is important to note that this version was not a change of military characteristics or requirements, but a closer fulfillment of the intent of the current requirements and represents an improvement which could be made without sacrificing time."[193]

Colonel Warden later reflected, "It took us two years to convince the Boeing people and later to sell the jet concept [to the Pentagon]."[194] Warden's recollections suggest that AMC, namely the Bombardment Branch, always wanted jet engines on the B-52, but it took time to convince senior officials and the manufacturer that it was the proper course.

November 10, 1948 The Office of the DCS/Materiel directed AMC to undertake a program of weight reduction and simplification for the XB-52. Included in this program were recommendations to add provisions for carrying conventional bombs, change the "special" bomb load from 15,000 pounds to 10,000 pounds, install a single inhabited .50-caliber turret with both optical and radar gun-laying capabilities in the tail, and delete a number of individual electronic systems and other equipment.[195]

November 17, 1948 Boeing received a supplemental agreement for two experimental XB-52s based on Model 464-35 at an estimated cost of $6.5 million.[196]

December 17, 1948 In a presentation to the Air Force, the Bombardment Branch provided justification for choosing the turbojet B-52 over the turboprop:

> "The tactical success of a bombing aircraft is a function of the ease of operation, flexibility of operation and ease of first echelon maintenance. From a tactical operational standpoint, the jet airplane provides considerable superiority of flexibility of increased cruising speed for shorter ranges. It unquestionably will have considerably less maintenance problems. From a cruise standpoint, cruise control is much simpler and much more flexible on the jet airplane than on the propeller airplane because of the power plant characteristics. It is believed without question that the tactical probability of the proposed B-52 is materially higher than that of the turbine-prop version by virtue of its superior speed and superior altitude."[197]

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[193] AMC, "XB-52 Presentation," 10 Nov 1949.
[194] *Gathering of Eagles*, Video Recording.
[195] MG Francis H. Griswold, Acting DCS/Materiel, to CG, AMC, Subj: Weight Reduction and Simplification of the B-52 Airplane, 10 Nov 1948, in Greene, Sup. Doc. 6.
[196] Bagwell, p. 19; Supplemental Agreement to CPFF Contract, in Bagwell, Sup. Doc. 139.
[197] Engineering Division, Presentation: "XB-52 and XB-55," 17 Dec 1948, pp. 11-12, in Box 3214: B-52 Bomber Files, Box 14, ASC/HO Archive.

1949

January 1949 The Air Force cancelled development of the XB-55 bomber. Despite its innovative design qualities, such as those applied to the new XB-52, the XB-55 program suffered from a lack of funds. The Air Force instead decided to stay with a follow-on B-47—the B-47B—as its medium bomber.

January 1949 The Bombardment Branch made another presentation to Air Force Headquarters in favor of the turbojet XB-52:

> "Consideration of a decision as to which configuration to pursue proposes two questions. When do we want the B-52 and how long a life do we project for this airplane? The simultaneous consideration of these two questions is important and cannot be divorced from the possibility of a requirement for early initiation of an improved heavy bombardment aircraft to take advantage of the latest advancements in the field of aerodynamics, propulsion and military requirements. If we base the decision of which configuration to continue the B-52 development on a delivery differential of a few months, the obsolescence of this earlier airplane will demand the concurrent development of an improved heavy bomber. …It is totally unrealistic within the present size of Air Force Budgets to contemplate in this short period the development of two aircraft of this size. Therefore, the configuration right or wrong of the B-52 will be a configuration which will live with the Air Force for many years. Can the Air Force or the Nation afford to expend $50,000,000 for the development of an airplane with early obsolescence?"[198]

AMC compared the two aircraft configurations in terms of technical problems, availability, tactical operation, adaptability, influence on the engine R&D program, supply, and maintenance. The turbojet airplane had far fewer technical problems than the turboprop. Requirements for assisted takeoff under extreme temperature conditions and deceleration chutes for solving landing problems during emergencies were already in development.

Problems peculiar to the turboprop were numerous. Perhaps most important, a successful propeller had not yet been designed to operate at speeds of 500 mph. In fact, most propellers in development or use exhibited structural limitations even at 300 mph. Successful development of the propeller-engine combination was dependent on several factors: failsafe propeller-engine control combination; development of successful dual rotation gearboxes and vibration mounts; and a high degree of cooperation between the propeller industry, engine manufacturer, and aircraft manufacturer. The turboprop airframe would not allow for material improvement in power plants in terms of higher speeds due to its high wing loading and thick airfoil. Finally, the turboprop engine had far more complex parts than the turbojet, making it a heavier supply and maintenance burden.

The B-47B, shown here with its deceleration chute deployed, made its first flight in February 1951. Requirements for the medium bomber included the capability of carrying both atomic and conventional weapons as well as photo-reconnaissance equipment. The bomber became operational in the fall of 1952.

Only in terms of availability did the turboprop come out on top, at least initially. The T35-5 engines could be available for production airplanes provided "a minimum of $5,000,000 is expended from 1950 Fiscal Year funds."

[198] Presentation No. 2, Jan 1949, in Greene, Sup. Doc. 7.

It was then noted, however, that the propeller-engine combination must undergo many more types of ground and flight tests to prove its success before it could be adapted to a production aircraft.[199]

Perhaps the most influential argument in favor of the turbojet B-52 was as a counter to the Navy's bid for the atomic weapons delivery mission. The Navy had long fought against an independent Air Force for fear that it would lead to the elimination of its own air mission. Both the Army and Navy agreed that airpower only served to strengthen ground and naval forces. Once the Air Force was made an independent service equal to the Army and Navy, the fight over the atomic mission, as well as other missions, accelerated. In an attempt to prevent duplicate development, in 1948, the Air Force was given responsibility for strategic air operations and the Navy was provided responsibility for sea operations. As part of its mission, the Air Force proceeded to develop the B-36 to deliver the atomic bomb. The Navy, however, envisioned an atomic strike force operating from aircraft carriers as part of its mission. The super-carrier under development would provide the Navy's aircraft with an extended range that the Air Force's intercontinental bomber, the B-36, could not match.[200] AMC indicated that

> "…the Navy is predicating the successful delivery on high speed and high altitude, considerably above that provided by the current propeller version of the B-52. It is further contemplating the development of a longer range, higher speed, delivery aircraft to insure this mission. With proper compromises of equipments and performance, such as inherent take-off characteristics and low altitude operation, it is within the technical state of the art to achieve the initial Navy objective and on the later time scale probably the second Navy objective. Therefore, if the Air Force is to remain competitive it must provide a vehicle which has comparable target zone performance."[201]

The threat of cancellation of the current B-52 program and reopening the competition to other manufacturers led the Bombardment Branch to argue:

> "Had we adhered to a policy of new competition for each new change of configuration, this would be the fourth competition. The medium bomber competition cost the aircraft industry over $1,500,000. If the Air Force were to buy a development on competition, change its mind four times, each time with a new competition, this would expend over $6,000,000 of the industry's money. I feel quite sure that the Air Force would lose the respect and faith of the industry, and would find it extremely difficult to find competitors in an industry financed competition…."

An estimated 18-month delay was expected if the competition was reopened.[202]

January 26, 1949 At a meeting at Air Force Headquarters, the Senior Officers Board[203] accepted Boeing's XB-52 turbojet design and authorized the company to continue development without a new competition. Major General Edward Powers, Assistant DCS/Materiel, directed AMC to "[c]ontinue development, with the Boeing Aircraft Company, of the XB-52 as a turbo-jet powered aircraft in lieu of the present configuration incorporating turbo prop power plants. It is understood that the turbo jet powered XB-52 will conform generally to Boeing Model 464-49."[204]

It was at this same time that AMC issued Supplemental Agreement No. 3 to Pratt & Whitney's basic contract. The $3 million allotted for the supplement covered the initial design of the complete XJ57 engine,

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[199] *Ibid*.
[200] Warren A. Trest, *Air Force Roles and Missions: A History* (Washington, D.C.: Air Force History and Museums Program, 1998), pp. 108, 118, 121.
[201] Presentation No. 2, Jan 1949.
[202] *Ibid*.
[203] The Senior Officers Board replaced the Aircraft and Weapons Board in late 1948. The four-member board included the Vice Chief of Staff of the Air Force, the deputy chiefs of staff for Materiel and Operations and the commanding general of AMC. Collins, *Cold War Laboratory*, p. 186.
[204] Greene, p. 11; MG E. M. Powers, Assistant DCS/Materiel, to CG, AMC, Subj: XB-52, 26 Jan 1949, in Greene, Sup. Doc. 9.

construction of a full-scale mockup, preparation of the engine specifications, and fabrication and component testing of the parts needed to convert an XT45 into a XJ57.[205] Pratt & Whitney had finished the design and development of the XT45 early in 1949, and shortly thereafter, the Air Force cancelled its development. The Power Plant Laboratory noted:

> "At this time, Pratt & Whitney presented a preliminary design study of a turbo-jet engine in the 9000 lb. thrust class utilizing some of the design features of the XT45 and taking advantage of the work already accomplished on the XT45.
>
> "The decision was made by the USAF to develop this engine which was then designated the XJ57. This engine was to be a high pressure ratio axial flow turbo-jet engine employing the two-spool compressor arrangement having a low specific fuel consumption and capable of operation up to 55,000 ft. altitude."[206]

The actual date of the Air Force's decision to continue development of the T45 as a jet engine is unknown, although the contract was officially changed in January 1949.[207]

February 10, 1949 General Putt, Director of Research and Development, responded to the DCS/Materiel General Craig's question: "Why are we building the B-52?":

> "The B-52 in its present configuration as a turbo-jet special purpose high speed long range aircraft is being developed as the replacement of the B-36 for delivery of the special weapon. …The major difference between the B-52 and the B-36 is one of time. The B-36 represents the solution to the strategic bombardment problem in 1942, whereas the B-52 is the solution in 1949. The B-36 was conceived in 1942 as a long range, high altitude, heavily armed, comparatively fast strategic bomber. It is felt to have considerable worth and potential for strategic air warfare in the next four to five years. Following that time it appears necessary that an airplane of considerably higher speed potential succeed the B-36. At present, due to the state of the art of aircraft design, and power plant capabilities, the B-52 as a turbo-jet bomber represents the best possible successor to the B-36. It is only by vigorously pursuing the development of the B-52, at this time, can the Air Force hope to have a suitable aircraft to carry out its mission of Strategic air war, specifically the delivering of [the] atomic bomb. It is felt that the Air Force would be remiss in their responsibilities if some successor to the B-36 was not, at this time, in the design stage. …The B-52 exceeds the B-36B capability in the following categories: high speed by 204 knots; cruise speed by 251 knots; altitude by 10,000 feet."[208]

February 19, 1949 Following on the heels of its defense of the turbojet B-52, the Bombardment Branch had to defend the B-52's "reasonably conventional approach as compared to throwing away the book and reaching out into the blue." This was a result of the Fairchild Corporation's proposal for an unconventional bomber "based upon using a railroad flat car as a take-off cart, and the expenditure of a large fuel carrying wing during each flight."[209] Once the fuel was depleted, the wing could be jettisoned. The auxiliary wing built into the "canard" type aircraft design was also to provide additional lift in heavy weight conditions.

The Bombardment Branch had been alerted to Fairchild's unconventional approach, referred to as the M-121, as early as September 1948. At that time, Major General Carroll, Director of Research and Development, informed the DCS/Materiel:

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[205] Technical Accomplishments of the Power Plant Laboratory, Fiscal Years 1946-1951, p. 10.
[206] *Ibid*.
[207] St. Peter, pp. 174-175.
[208] BG Donald L. Putt, Dir of R&D, DCS/Materiel, Memorandum for the DCS/Materiel, Subj: XB-52, 10 Feb 1949, in Greene, Sup. Doc. 12.
[209] AMC, "XB-52 Presentation," 10 Nov 1949.

> "The Fairchild proposal, based on a preliminary viewing, would appear to have attractive performance; however, when subjected to a more detailed analysis of assumptions, development problems and deficiencies, any gains appear to be a result of the concept of minimum crew and equipment and a number of unproven ideas, rather than as a result of the "Canard" type of design."[210]

Fairchild representatives bypassed the Engineering Division and went straight to Chief of Staff Hoyt Vandenberg, who had replaced Spaatz in April 1948. When asked if they had first gone to AMC, the Fairchild reps reportedly said yes, "but those people have got their heads in a bucket of cement."[211] Vandenberg requested cancellation of the B-52 and adoption of the Fairchild proposal.

Not having convinced Air Staff by its earlier arguments against Fairchild's design, AMC, specifically the Bombardment Branch, reiterated its stance in February 1949 and also stressed the need for development of a single design for any one concept due to funds and time limitations:

> "It is important to note that the Air Force is permitted within its available funds to initiate very few new developments. Therefore, each new development should bite off the largest bite of advancement that can be digested in the period allowed for that development. The amount of progress which can be made is proportional to the risks taken in the development. Because of the extended time and large amounts of money required for development, the Air Force can only afford to take gambling risks, that is an abnormal amount of risks, provided that it can carry parallel or concurrent developments…."

While praising the Fairchild proposal as "the type of thinking which we encourage in the industry," the Bombardment Branch estimated that initiating the Fairchild program would result in three to six years' delay in an available airplane for SAC. Furthermore, the airplane would lack growth potential in range and altitude and would require additional funds for new wings for every mission, thus presenting logistic problems. The Branch conceded that

> "[t]he B-52 is not the optimum solution to the range problem, but it is believed [it] represents the best balance between ease of maintenance, tactical security, versatility of use, etc., that is possible at the current state of the art. …If the Air Force can accept the additional calculated risks and additional delays of three to six years in obtaining a more radical approach, then such a development philosophy should be made known to the industry. There are many, many ways of accomplishing the range problem, if we are willing to accept this magnitude of compromises, and the industry will come up with a dozen or more novel ideas that are at least equivalent to the Fairchild [proposal]."[212]

In the meantime, the Branch argued that it needed to continue the development of the XB-52. Based on the Bombardment Branch's arguments and a review of the B-52's potential growth, "the Senior Officers Board decided to continue the conventional approach with the B-52…."[213] General Putt, who had replaced Carroll as Director of Research and Development in the DCS/Materiel, stated:

> "On the basis of testimony presented, it appeared to the Board that the projected development to be expected in the B-52 was superior to any other proposal. The B-52 will also be available in

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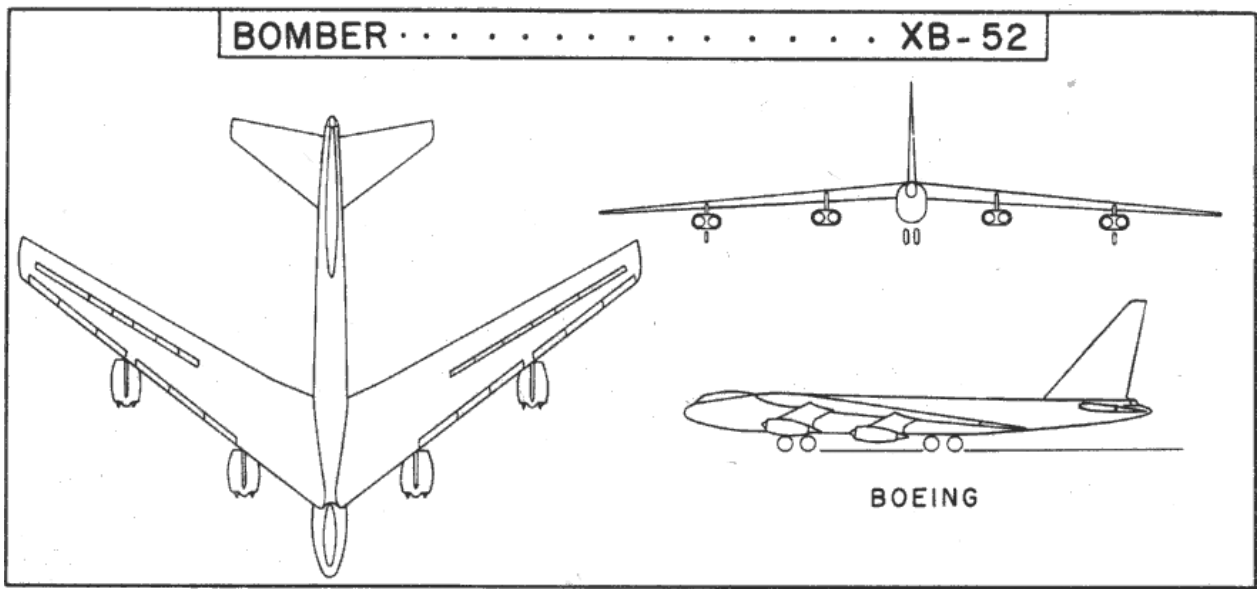
[210] MG F. O. Carroll, Dir of R&D to DCS/Materiel, Subj: Study of Proposed Specification for a Heavy Bombardment Aircraft, 23 Sep 1948, in Box 3057: Aircraft/Bomber, Box 4, ASC/HO Archive.
[211] Warden, Interview with Lori Tagg; Warden, Interview with Hugh Ahman.
[212] Untitled Presentation, 19 Feb 1949, in Box 3055: Aircraft/Bomber, Box 2, Development, ASC/HO Archive.
[213] AMC Presentation, 10 Nov 1949.

production at least three years earlier than any aircraft of as radical design as that proposed by the Fairchild Corporation."[214]

The Board, however, recommended that industry continue to think about advanced designs and that when funds permitted, "the Aircraft Industry be circularized for a new, modern, possibly unconventional, approach to the intercontinental bomber problem. Prizes should be awarded to the winning design or designs."[215] Approximately one month later, AMC received a directive from the Secretary of the Air Force to request proposals from industry for possible unconventional approaches to the intercontinental bomber. "It was not a budget item, and as yet no action has been initiated."[216] Colonel Warden later recalled that he never acted on the directive because the Branch had better things to spend money on and the Air Force never provided additional funds for the design competition.[217]

March 10, 1949 AMC attached Supplemental Agreement No. 5 to Boeing's contract authorizing initiation of Phase II. This supplement covered a mockup and two experimental airplanes of the XB-52, Model 464-54, which Boeing listed as the Phase II version of the Model 464-49.[218]

March 14, 1949 Anthony F. Dernbach, Chief of the Aerodynamics Branch, Propeller Laboratory, Engineering Division, submitted a Memorandum Report titled "A Study of the Relative Merits of Turbo-Propeller versus Turbo-Jet Propulsion as Applied to the Long Range Heavy Bomber Requirement." He concluded:



Three-view diagram of the B-52 design, Boeing's Model 464-54, dated June 30, 1949

[214] BG D. L. Putt, Dir of R&D, DCS/Materiel, to CG, AMC, Subj: Heavy Bombardment Development Program - Recommendations of Board of Officers, 1 Apr 1949, in History of the B-52 Supplement, 1948-1950, Box 3203: B-52 Bomber Files, Box 3, ASC/HO Archive.
[215] MG E. M. Powers, Asst. DCS/Materiel, to CG, AMC, Subj: Brief of the Recommendations of the Board of Officers Concerning Changes in the Procurement Program and the R&D Program of the USAF, 30 Mar 1949, in History of the B-52 Supplement, 1948-1950, Box 3203: B-52 Bomber Files, Box 3, ASC/HO Archive.
[216] AMC Presentation, 10 Nov 1949.
[217] Warden, Interview with Hugh Ahman.
[218] Boeing, pp. 5, 10, 34.

> "On the basis of performing a prescribed heavy bomber mission, the use of turbo-propeller power plants in preference to turbo-jets will result in drastic savings of airframe weight and fuel required. …These savings in airframe weight and fuel per airplane per mission, when multiplied by the numbers of airplanes and missions involved in any major war effort could make a serious difference in the national resources picture. Today there is a tendency to eliminate further development of propeller driven engines. …In view of these advantages it is believed that a serious mistake will be made if in fact such a turbo-propeller development is curtailed. …In summary, the airplane studies reported herein show that at the speed, ranges, and altitudes being required today, the turbo-propeller system of propulsion will result in a far superior airplane to the turbo-jet; and that the maximum development of the turbine engine requires a propeller for its maximum utilization."

Instead of curtailment of turboprop programs in favor of turbojets, Dernbach recommended simultaneous development programs, "if the nation is not to run the risk of finding itself with inferior weapons in certain extremely important categories."[219]

In response to Dernbach's report, Ed Wells, Boeing's Vice President of Engineering, responded that "…it is very likely…that airplane development progress will be so rapid that there is no necessary place for the turbo-prop power plant. If they were to have a place, it was probably three years ago. Three years from now the jet engine will probably fill the needs for most new airplanes."[220] The change of the B-52 design from turboprop to turbojet essentially marked the end of the Air Force's interest in turboprop engines until the development of the Allison T56 for the C-130 transport in the early 1950s.[221]

April 5, 1949 The Air Force decided to pursue the development of reconnaissance requirements in the B-52. Although the requirement for the B-52 to have provisions for reconnaissance equipment had been included in the March 3, 1948, characteristics, little work had been completed along these lines. In fact, the Air Force's proposed strategic reconnaissance aircraft at this time was the XR-16, military characteristics for which were approved in August 1948 and issued to industry in October. At the AMC Conference on April 5, 1949, it was announced that

> "…since no funds have been available for the development of an aircraft to meet the [strategic reconnaissance] requirements established by Military Characteristics dated 3 August 1948, Hq. USAF has been advised that studies will be made of the reconnaissance version of the B-52 airplane since it has been changed to a turbo-jet configuration making the performance comparable to that established for the Strategic Reconnaissance Aircraft."[222]

Consequently,

> "[t]his study was submitted to Hq, USAF, and in March 1949, Hq, USAF cancelled the XR-16 and instructed that a program directed toward production line modification of B-52's to RB-52's be implemented. Such a program was established by letter contract AF 22076 calling for a Phase I study and mockup of the XRB-52. Previous studies were conducted around the requirement for convertibility from bomber to reconnaissance type aircraft; therefore a pod type concept as presented by the mockup has been evolved."[223]

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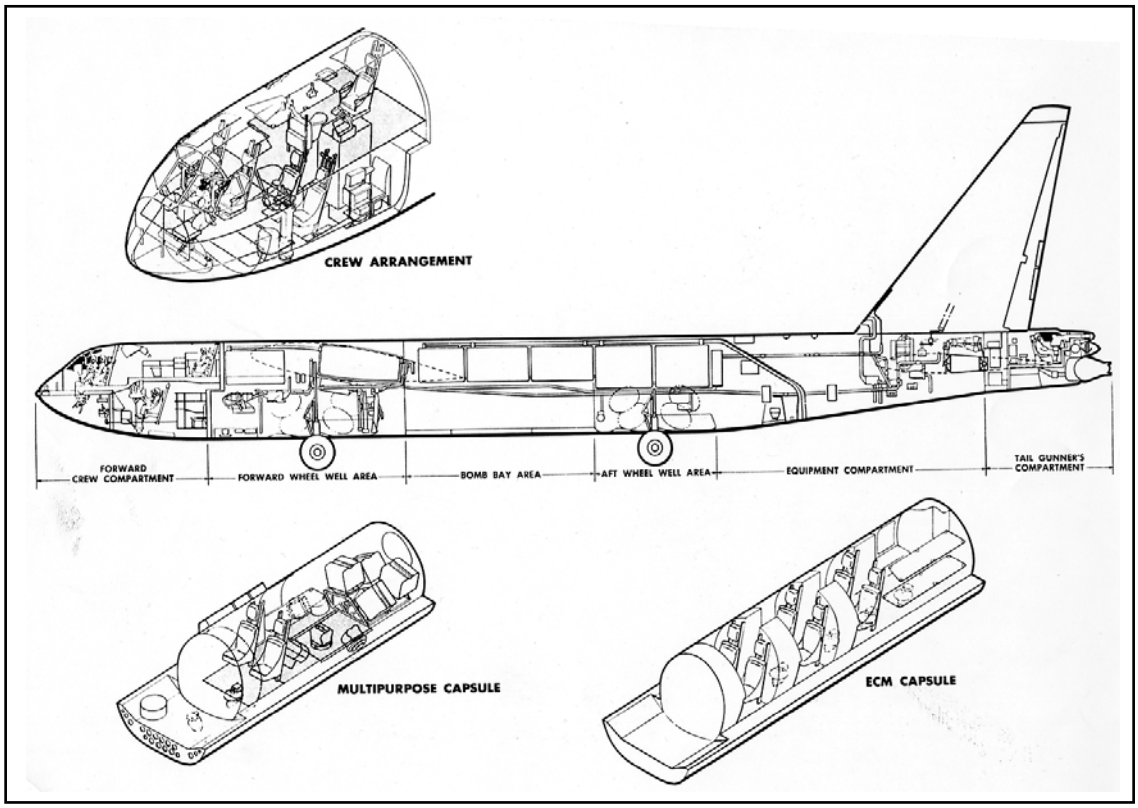
[219] Anthony F. Dernbach, "A Study of the Relative Merits of Turbo-Propeller versus Turbo-Jet Propulsion as Applied to the Long Range Heavy Bomber Requirement," 14 Mar 1949, in Greene, Sup. Doc. 13.
[220] Quoted in Greene, p. 24.
[221] The development of the Pratt & Whitney T34 turboprop was the one exception. Designed and tested in the late 1940s, it went into production in 1953 for the Douglas C-133 Cargomaster. St. Peter, pp. 170, 236-237.
[222] Minutes of the AMC Conference, 5 Apr 1949, p. 6, AFMC/HO Archive.
[223] Memorandum, Subj: B-52A and XRB-52 Mockup Military Characteristics dated 3 Oct 48 established characteristics for a Strategic Reconnaissance Aircraft, Appendix VII-1cc to Weapons Systems Division, Memorandum Report on Conference on RB-52 Airplane Configuration and Equipment Requirements, 20 Sep 1951, in Greene, Sup. Doc. 73, p. 65.



The reconnaissance pods were designed to fit within the bomb bay of the B-52 and to be removable so the airplane could quickly be converted to a bomber. Boeing designed several single-mission pods and one multi-purpose pod.

April 25-26, 1949 The mockup inspection of the turbojet-powered XB-52 [Model 464-54] was held at the Seattle plant. Colonel Warden remembered that

> "…when we went to the mockup of the B-52 with four twin engine nacelles we did not know where we were going to put the inboard nacelles. With a long swept wing, you always have the potential for flutter problems…. We didn't have the answer to it, but we had a flutter program as part of the wind tunnel program, and we felt confident that…we were going to have the answer…."[224]

Additional concerns revolved around the fact that the J57 engine needed significant improvement to give the new bomber the required range.[225] The mockup included the J40 engines because the J57 engines were not yet ready, and the board's report noted that

> "…the initial experimental aircraft using J-40-6[226] engines will not meet the 4,000 nautical mile radius of the B-36. It is anticipated that the production aircraft, through the expedited development of the J-57 will eventually have a combat radius of 4,000 nautical miles. …The prognosticated time for accomplishment of this radius is 1954."[227]

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[224] *Gathering of Eagles*, Video Recording.
[225] Knaack, p. 217; Rothman, *Acquisition Milestones,* p. 79; Boeing, p. 35; Greene, pp. 12, 13.
[226] Modern nomenclature for turbojet and turboprop engines omits the hyphen (i.e., J40, J57). However, for this publication, hyphens present in documents dating to the 1940s and 1950s have been retained when quoted directly.
[227] MG Francis H. Griswold, Assistant DCS/Materiel, Air Staff Summary Sheet, 25 Aug 1949, in Greene, Sup. Doc. 23.

May 18, 1949 A mockup inspection of the power plant installation, ATO installation, and cockpit lighting was conducted at Boeing's Seattle plant. The consensus was "satisfactory with only a very limited number of requests for alteration or change…."[228]

June 1949 A supplemental agreement for $2 million was added to Pratt & Whitney's contract to manufacture two XJ57-P-1 engines. This agreement covered 50 hours of full-scale engine development testing; static load testing to demonstrate the ability of the engine to withstand simulated flight maneuver loads; and modification of a government-furnished B-50 bomber for use as a flying test bed.[229]

Pratt & Whitney's J57 engine with R-2800 piston engines in background, 1953 (*Pratt & Whitney Archives*)

June 21, 1949 Representatives from Air Force Headquarters, SAC, and Air Weather Service (AWS) attended a conference at AMC headquarters to determine the reconnaissance equipment requirements for the XB-52. In order to maintain the range performance, it was stressed that the weight of the reconnaissance-related personnel and equipment should not exceed the bomb load. When the equipment, personnel, and provisions were combined, the reconnaissance equipment could weigh only 7,500 pounds if the airplane was to maintain the same range. At this time, the reconnaissance equipment weighed 13,500 pounds, 3,500 pounds heavier than the bomb load.

The conference broke down when SAC and Air Force Headquarters representatives failed to agree on the appropriate emphasis of the plane's mission. SAC believed it needed to carry the maximum electronic reconnaissance equipment, while Air Force Headquarters believed emphasis should be on photographic equipment. The conference concluded with the statement that "a firm definition of mission" was needed so that "rational compromise of reconnaissance equipment may be made."[230]

July 12, 1949 AMC announced that the bicycle-type landing gear on the XB-52 had been replaced with quadricycle-type gear.[231] The Engineering Division analyzed 15 different landing gear configurations "to determine the optimum configuration compatible with existing runway and taxiway systems" before supporting Boeing's suggested change. A benefit of the quadricycle gear was the additional ground clearance for bomb loading, deleting the requirement for a pit. The Engineering Division also

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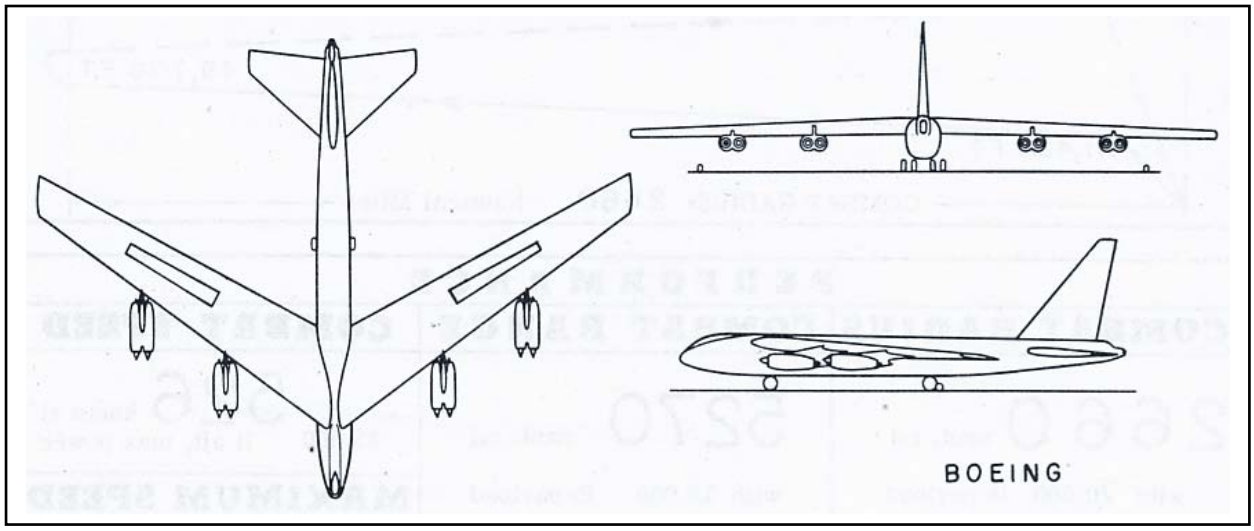
[228] Engineering Division, Monthly Project Reports, May 1949, p. 35, in Box 2018: Organizations/Engineering Division, Box 6 of 11, ASC/HO Archive.
[229] Technical Accomplishments of the Power Plant Laboratory, Fiscal Years 1946-1951, p. 11.
[230] G. W. Hobson, Project Engineer, Reconnaissance Aircraft, Bombardment Branch, Aircraft Projects Section, Memorandum Report on Conference to Determine Equipment Requirements for Reconnaissance Version of XB-52 Airplane, 27 Jun 1949, in Greene, Sup. Doc. 17.
[231] Boeing p. 10; Minutes of AMC Conference, 12 Jul 1949, p. 4, AFMC/HO Archive.



Three-view diagram of the B-52 design (Model 464-67) dated December 23, 1949, showing quadricycle landing gear as approved by the Air Force in July

determined that "for abnormal conditions, such as hard landings, wing low landings and excessively sharp turns, it is necessary to provide a tip protection gear…."[232]

August 29, 1949 The Soviet Union detonated its first atomic bomb.[233] Up until this time, the United States had been the only nation with atomic capability, giving it a certain sense of invulnerability. With the Soviet Union's possession of atomic capability, the United States was suddenly exposed to a disastrous attack. The capability to deliver the weapon in a swift retaliatory attack became more important than the quantity of weapons in stock.[234] This made the production of the long-range B-52 even more important to American security. The event also spurred American development of the hydrogen, or so-called "super," bomb.

August 1-2, 1949 A mockup inspection of the XJ57 engine was conducted at Pratt & Whitney's plant in Hartford, Connecticut. Frederic G. Hoffman, the project engineer, stated, "In defense of the engine it is apparent that Pratt and Whitney is attempting to furnish an engine for a bomber application. The compression ratio is high, the altitude characteristics better than usual, and the specifics very good."[235]

August 15, 1949 Pratt & Whitney submitted a specification for an interim engine designated the XJ57-P-3 (JT3-10B) to power the initial flight tests of the XB-52. According to historian James St. Peter, the engine manufacturer essentially submitted an entirely new design because tests of the earlier models of the XJ57 (known by Pratt & Whitney as the JT3-10A) yielded less thrust than anticipated, were overweight, and exhibited other characteristics of "faulty design approach."[236] At the same time, the Air Force was considering the use of advanced models of the J40 engine in the early production B-52s.[237]

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[232] Engineering Division, Monthly Project Reports, Jul 1949, p. 43, in Box 2018: Organizations/Engineering Division, Box 6 of 11, ASC/HO Archive; Col A. T. Culbertson, Acting Chief, Aircraft Projects Section, Engineering Division, to Dir of R&D, HQ, USAF, Subj: XB-52 Landing Gear Configuration, 13 Oct 1949, in Greene, Sup. Doc. 28.
[233] Shaw and Warnock, *Cold War and Beyond,* p. 7. Also see David Holloway, *Stalin and the Bomb: The Soviet Union and Atomic Energy, 1939-1956* (New Haven: Yale University Press, 1994).
[234] At the time, the raw materials to make an atomic weapon, particularly uranium, were thought to be in short supply.
[235] Frederic G. Hoffman, Project Engineer, Report on Mock Up Board of XJ-57 Engines, 1 Aug 1949, in Greene, Sup. Doc. 21.
[236] St. Peter, p. 175; Greene, p. 27.
[237] Greene, pp. 25, 28.

General Muir S. Fairchild became Vice Chief of Staff of the U.S. Air Force in May 1948. Prior to that time, he had been Director of Military Requirements and Commander of Air University at Maxwell Field, Alabama.

Orval R. Cook first arrived at Wright Field in 1929 to attend the Air Corps Engineering School and upon graduation was assigned to the Aircraft Branch at Materiel Division headquarters. While at Wright Field, he also served as Chief of the Production Division and Director of Procurement and Industrial Mobilization Planning. In the early 1950s, he became Deputy Chief of Staff for Materiel.

September 7, 1949 The Engineering Division reported that Pratt & Whitney had successfully modified the T45 turboprop engine into a J57 turbojet engine.[238]

October 1, 1949 General Muir S. Fairchild, Air Force Vice Chief of Staff, approved the XB-52 Mockup Report. He noted, however, that this approval was based on "assurances that the J-57 will permit production articles to meet 4000 nautical miles [radius] requirements [4,600 statute miles] and in the interest of expediting production; however this approval does not include acceptance of any production article not meeting specified range requirements."[239] Fairchild's directive was seen as being a "cancellation of the program as it now exists."[240]

October 11, 1949 Major General Orval R. Cook, Director of Procurement and Industrial Planning at AMC, suggested another review of the B-52 program and that "it may be very logical for the Air Force to again reopen competition for this airplane for the purpose of accelerating the date of its availability through the incentive of competition." Cook's request was a result of the mockup inspection held in April 1949, during which it became obvious that the B-52 with the J57 engines would have less range than the B-36 it was supposed to replace and that the B-52 might not be able to meet the range requirement until 1957.

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[238] Minutes of the AMC Conference, 1 Sep 1949, p. 15, AFMC/HO Archive.

[239] Emphasis in original. Griswold, Air Staff Summary Sheet, 25 Aug 1949, in Greene, Sup. Doc. 23, with handwritten note by Gen Fairchild.

[240] Lt Col J. C. Maxwell, Bomber Section, Memorandum for Chief, Aircraft Branch, Directorate of R&D, DCS/Materiel, HQ, USAF, Subj: XB-52 Mockup Approval, 11 Oct 1949, in Greene, Sup. Doc. 27.

This issue was especially sensitive to the Air Force because of the recently settled B-36 investigation, or "Revolt of the Admirals,"[241] which stemmed from the long-held Air Force and Navy disagreement over the atomic mission (see January 1949). The controversy came to a head when the fiscal year 1950 budget cancelled the Navy's super-carrier in favor of the Air Force's B-36. The Secretary of the Navy, John L. Sullivan, resigned in protest and other Naval officers levied harsh criticism at the performance of the intercontinental bomber, suggesting that the B-36 procurement decision was wrought with collusion. In August 1949, the House Armed Services Committee announced that it had found no evidence of wrongdoing on the part of the Air Force in procuring the B-36 bomber, and that the B-36 was the best airplane for the mission at that time. The Committee's conclusions did not end the controversy, however. Throughout the year, the Navy continued to attack the Air Force, pointing out that the Air Force was focusing all of its efforts on strategic bombing to the detriment of tactical and air defense operations. The capabilities of the B-36 itself were also attacked.[242]

In its defense, the Air Force called attention to its development of the B-52, a long-range bomber with improved speed, altitude, and range performance over the B-36. In order to maintain that promise, the B-52 had to meet the requirements under which it was being developed. "[I]t has been publicly stated that the B-52 airplane would replace the B-36. In making this statement, we have implied that it would replace the B-36 in every respect, including range."[243]

Others in the Pentagon felt the same way. Lieutenant Colonel Jewell C. Maxwell in the Bomber Section of the Aircraft Branch, DCS/Materiel, stated:

> "I do not believe the B-52 as presently designed could possibly meet this range requirement before 1956, even if we initiated design of an engine specifically to meet this requirement. It is my opinion that if the range requirement is to be met, we should immediately realign the program to take advantage of the latest thinking in engine design, specifically the ducted fan engine….
>
> "There are other methods…which might add to the radius. …If mechanical dodges cannot be used then we should revise our whole thinking in connection with this airplane."[244]

At the same time, the laboratories at Wright Field, angry that they had been bypassed in many of the decisions made by the Bombardment Branch, requested confirmation of Boeing's wind tunnel studies.[245] The Engineering Division approached NACA about performing additional wind tunnel tests at the Ames Aeronautical Laboratory to check Boeing's performance calculations, particularly as they pertained to the variable thickness ratio wing:

> "A number of fundamentally new concepts have been incorporated in the design of this airplane in order to improve its aerodynamic and structural characteristics. …Considerable study relating to these new ideas and their application to the XB-52 airplane has been accomplished by the Boeing

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[241] As referred to in Herman S. Wolk's "The Battle of the B-36," *Air Force Magazine*, July 1996, viewed online at http://www.afa.org/magazine/july1996/0796battl.asp.

[242] Trest, pp. 126-128, 130-131.

[243] MG Orval R. Cook, Dir, Procurement and Industrial Planning, Routing and Record Sheet, 11 Oct 1949, in Greene, Sup. Doc. 26.

[244] Maxwell, Memorandum, Subj: XB-52 Mockup Approval, 11 Oct 1949, in Greene, Sup. Doc. 27. In late 1948, NACA issued a report with conclusions from comparison testing turboprop, turbojet, and ducted-fan engines. "The ducted-fan type of turbojet engine represents an attempt to combine the fuel economy of a propeller-type engine with the light weight of a turbojet engine. A ducted-fan turbojet engine…requires the installation of a more powerful turbine to drive a relatively small-diameter multibladed propeller in addition to the normal compressor. All or part of the air…that is handled by the propeller, or fan, is passed through a separate duct." Simplified, NACA's conclusion regarding the range of the three engines was as follows: "If flight speeds do not exceed a flight Mach number of approximately 0.6, the turbine-propeller engine should offer the most favorable performance of any of the engines considered. If, however, higher flight Mach numbers are desired, the turbojet engine with tail-pipe burner…should provide the greatest flexibility of all engines considered." At Mach 0.6, the ducted-fan engine showed a five percent increase in range over the turbojet, but at higher Mach numbers, the increase was "negligible." Richard B. Parisen, John C. Armstrong, and Sidney C. Huntley, *Theoretical Evaluation of the Ducted-Fan Turbojet Engine*, NACA Technical Note No. 1745 (Washington, D.C.: November 1948), pp. 2, 11, viewed online 15 January 2004 at http://naca.larc.nasa.gov/reports/1948/naca-tn-1745/.

[245] *Launching the B-52*, Part II, Video Recording.

> Aircraft Company. However, the importance of this airplane to USAF planning makes it mandatory that every possible means be used to assure the success of this project."[246]

The Boeing representatives later recalled that the Ames tests provided more data, but essentially proved out the manufacturer's calculations.[247]

October 12, 1949 General LeMay, now commander of SAC, expressed to Colonel Warden his dissatisfaction with the emphasis of the B-52 program during a meeting at Offutt Air Force Base. Stressing that he would not accept longer range at the expense of speed, LeMay recommended that the J57 power plant be given precedence over all other engine development programs. The proper emphasis on the engine would allow the program to meet range requirements and the production schedule.[248]

November 1949 The XB-52 again faced threats of cancellation due to range problems. The procurement organization at AMC refused to initiate production until Boeing could prove that the aircraft would meet the range requirements.[249] Consequently, the Bombardment Branch of the Engineering Division directed Boeing to submit a new proposal:

> "Increases in design weight up to 390,000 pounds, refueling over home base, over weight refueling, estimated future improvements in power plant performance up to 1955, weight savings, and the effect of adding a 35 foot floating wing tip extensions [*sic*] were among the items investigated."[250]

Boeing then submitted a design for the 390,000-pound Model 464-67 with an estimated radius of 4,353 statute miles in 1953 production models and 4,813 miles in 1957 models.[251]

In addition to improved range performance, the increased weight also provided room for growth of the B-52: "At this weight, on an interim basis, the percentage of missions which would require refueling could be materially reduced and within the development period for this project, it was felt that refueling could ultimately be eliminated."[252]

Boeing recommended a pneumatic system to power the airplane's auxiliary functions and installation of tactical equipment in the second experimental airplane. They also believed that the XJ57 engines should be installed in the experimental versions, instead of the J40s:

> "Since approximately six months delay over current contract flight dates is involved in this change J-57 engines and pneumatic accessory power equipment can be made available for the first airplane. Although this change would increase the cost of the two experimental airplanes it will have the effect of reducing the initial cost of production airplanes and accelerating the possible delivery date on the first production airplane. On this basis it should be acceptable to Air Force personnel, and every effort is being made to obtain acceptance."[253]

November 1, 1949 Jane's All the World's Aircraft reported that the USSR had two types of four-jet engine bombers to carry their atomic bomb. At the AMC Conference held on this date, representatives from the Intelligence Department stated:

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[246] Col Floyd B. Wood, Chief, Operations Office, Engineering Division, AMC, to Dr. Hugh L. Dryden, NACA, no subj., 29 Nov 1949, in History of the B-52 Supplement, 1948-1950, Box 3203: B-52 Bomber Files, Box 3, ASC/HO Archive.
[247] *Launching the B-52*, Part II, Video Recording.
[248] Lt Col J. C. Maxwell, Directorate of R&D, DCS/Materiel, Memorandum for the Record: B-52 Program, 14 Oct 1949, in Greene, Sup. Doc. 29.
[249] Edward C. Wells to William M. Allen, 31 Jan 1950, in History of the B-52 Supplement, Jan – Dec 1950, pp. 23-25.
[250] Boeing, p. 39.
[251] Knaack, p. 218.
[252] Ljunggren, Presentation, 22 Apr 1950, pp. 1-2.
[253] Wells to Allen, 31 Jan 1950, p. 3, in History of the B-52 Supplement, Jan – Dec 1950, pp. 23-25.

> "Although reports have indicated that the development of the Ju-287 has been continued, it is not believed to be in production. There is no evidence that the Ilyushin bomber is in production and to date only two have been seen. Considering the display of the numerous jet fighters in recent air shows, it is the estimate of the Intelligence Department that fighter aircraft development still maintains a higher priority than bomber development. However, if the Soviets deem it advisable to place a higher priority on the development of jet bombers, it is estimated that they could have an effective force in a relatively short period of time."[254]

November 10, 1949 Lieutenant Colonels Pete Warden and Thomas Gerrity, the latter Chief of the Bombardment Branch in the Procurement Division at AMC, delivered a presentation of the B-52 program at Air Force Headquarters. Following the presentation, General LeMay stressed that SAC needed the B-52 by 1954, because he believed that date to be "the end of the useful operational life of the B-36" due to advancements in Soviet guided missiles. LeMay agreed to accept a B-52 only if it had an unrefueled radius of 4,313 statute miles at no sacrifice in speed. He further voiced his objection to "any deliberate planning" of using aerial refueling "as a means to achieve required operational radius." LeMay also stated that he wanted at least six service test aircraft for flight test because "the only effective method of debugging is to fly."[255]

December 6, 1949 The Procurement Division of AMC reported that it issued a contract to Pratt & Whitney for the delivery of 18 prototype YJ57-P-3 engines beginning May 1951. "These represent the first of a new high-thrust type engine being developed under an accelerated development program for early testing of the Boeing B-52 jet bomber."[256]

December 13, 1949 The more advanced YJ57-P-3 engine was chosen to power both of the experimental B-52s instead of the J40 series engines being developed by the Navy through the Bureau of Aeronautics.[257] The Engineering Division indicated that the Bureau of Aeronautics was reluctant to make changes to the J40 engine to make it suitable for B-52 use.[258]

December 15, 1949 General Putt, Director of Research and Development in the Pentagon, ordered AMC to study the feasibility of using the B-47C (with two aerial refuelings) to accomplish the strategic bombing mission slated for the B-52. Warden traveled to Washington to respond to the directive. Using the example of B-47 bombers with B-50 tankers, Warden estimated that for each bomber, SAC would require three tankers. The cost of this arrangement was estimated to be approximately $100 million higher than the B-52 program. Furthermore, SAC would need about 24,000 more crew members, resulting in higher personnel and training costs. The B-47C fleet would require approximately 2.7 million gallons of fuel in excess of the B-52 requirement, as well as more air strips and depot facilities for the tankers. Warden

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[254] Minutes of the AMC Conference 1 Nov 1949, p. 5, AFMC/HO Archive. The Junkers Ju-287 was a forward swept-wing bomber in development in Germany during World War II. The Ju-287 V1 was test flown in 1944, and a second prototype was in development when Soviet troops captured the Junkers facility in 1945 and relocated the entire design team to the Soviet Union. The V2 was completed and test flown, but the Soviets decided to discontinue work on the unconventional jet bomber. The Ilyushin bomber is believed to be the IL-22 which was test flown in 1947. It was not produced in quantity. Leonard Bridgman, ed., *Jane's All the World's Aircraft, 1949-1950* (New York: McGraw-Hill Book Co., Inc., 1949), p. 159c.

[255] Greene, pp. 14, 15; Lt Col J. C. Maxwell, Chief, Bomber Section, Aircraft Branch, Directorate of R&D, DCS/Materiel, Memorandum for the Record: B-52 Conference, 22 Nov 1949, in Greene, Sup. Doc. 31; Brown, *Flying Blind,* p. 146. The B-52 could not immediately meet the range requirement and General LeMay was forced to accept aerial refueling. Through successive models, however, the B-52 (H model) eventually grew to have an unrefueled radius of 4,176 miles. In 1962, a B-52H flew a record-breaking 12,532-mile unrefueled flight from Okinawa to Spain. Knaack, pp. 289, 293.

[256] Minutes of the AMC Conference, 6 Dec 1949, p. 9, AFMC/HO Archive.

[257] Col Carl F. Damberg, Chief, Aircraft Projects Section, Engineering Division, to Boeing, Subj: XB-52 Airplane Engine Installation, 13 Dec 1949, in History of the B-52 Supplement, 1948-1950, Box 3203: B-52 Bomber Files, Box 3, ASC/HO Archive.

[258] Engineering Division, Monthly Project Reports, Jan 1950, p. 22, in Box 2018: Organizations/Engineering Division, Box 6 of 11, ASC/HO Archive.

concluded, "From the data available for this interim study, it would appear that the B-47 and these tankers to do the same role would be a much more costly program than the B-52."[259]

1950

January 23, 1950 Research and Development Command (RDC) was established, with Major General David M. Schlatter as commander. The RDC became the Air Research and Development Command (ARDC) in April 1951.

January 27, 1950 Colonel Carl F. Damberg, Chief of the Aircraft Projects Section, Engineering Division, requested that the Aircraft Laboratory study the feasibility and potential performance attainable by installing turbine engine-supersonic propeller power packages on the B-47 and XB-52 airplanes:

> "Time limitations appear to limit this study to use of the [Allison] T-40 and turbo-dyne type engines, with possible consideration of a propeller turbine version of the J-57. …B-52 studies should consider engines for a 1952 airplane and improved versions of these engines as well as a prop turbine J-57 for a 1955 B-52."[260]

The request seemed to come at the same time RAND was pushing SAC on the results of its strategic bombing systems analysis project begun in 1946 at the request of the AAF and previously delivered to the Aircraft and Weapons Board in September 1947. In nearly three years, its conclusions had not changed. Included among its many suggestions was the idea that the Air Force might carry out its strategic bombing mission more efficiently by procuring larger numbers of smaller, less capable bombers—in RAND's analysis, turboprop airplanes—than to procure smaller numbers of high performance bombers, such as the B-52. By supporting the "adequate" bomber, as it is referred to in Collins' treatise on RAND, more airplanes would be available in production sooner than the B-52, thus more quickly creating the "air force-in-being" advocated by many Air Force officials.[261]

Colonel Warden immediately expressed his distaste for RAND's proposal. As he recalled:

> "I was in the Pentagon and we had a strategic committee that took a look at that. For three days we discussed this. At the end of the third day, nobody could find any faults with the assumptions. …I said, '…Give me twenty minutes tomorrow morning….' The next morning, I went in and I said, 'All I want to do is be sure that we agree on these assumptions.' Assumption Number One, right out of RAND['s report]; Assumption Number Two, Number Three, right out of RAND. Everybody started to go to sleep. Assumption Number Four: this airplane will never be required to carry a hydrogen bomb. The SAC guy came alive. He said, 'Where does it say that?' I said, 'Well, the

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[259] Col Frederick R. Dent, Jr., Deputy Chief of Engineering Division, AMC, to Director of Research and Development, Hq USAF, subj.: B-47 Refueling Study, 4 Jan 1950, in Presentation: "B-47 Refueling Study" given by Lt Col Warden to Hq USAF, 5-6 Jan 1950, in Box 3198: Aircraft/B-47 Box 2, ASC/HO Archive.

[260] Col Carl F. Damberg, Chief, Aircraft Projects Section, Engineering Division, Routing and Record Sheet to Aircraft Laboratory, 27 Jan 1950, in History of the B-52 Supplement, Jan – Dec 1950, p. 21. Damberg refers to the Allison T40 and the Northrop Turbodyne turboprop engines, which were being considered for use on a EB-35 flying wing test bed. The Navy contracted with Allison for development of the T40 in 1946 and eventually used the engine in its Convair R3Y-1 Tradewind and later for experimental aircraft in its Vertical Take-off Program. The Turbodyne engine was a Northrop in-house development begun in 1940 and supported by a 1941 joint contract from the Navy and Army. The Navy dropped out of the program in 1944, and the Army subsequently contracted for a more powerful version, designated the XT37, or Turbodyne II. St. Peter notes that the T37, which in 1948 achieved 10,000 horsepower, was chosen as an alternate engine for the B-52 and was more powerful than the B-52's chosen engines, the T35s. The Turbodyne program ended with the switch to turbojets on the B-52 and cancellation of the EB-35. St. Peter, pp. 72-74, 231-234; James O. Young, *Lighting the Flame: The Turbojet Revolution Comes to America* (Edwards AFB, CA: Air Force Flight Test Center History Office, 2002), p. 11.

[261] Collins, *Cold War Laboratory*, pp. 173, 178, 179.

Engineers inspect one of the YB-52's J57 engines in its nacelle (*Pratt & Whitney Archives*)

> answer that comes out here is an airplane that's too small to carry a hydrogen bomb….' And then I said, 'And this airplane will never be required to be a reconnaissance aircraft.' Well, that brought the reconnaissance [guy alive]. We had in the B-52 reconnaissance version, at one time, eleven thousand pounds of reconnaissance gear. You can't put that in a small airplane."[262]

Collins reported that LeMay also was put off by the "numbers versus performance" argument, but that he later agreed the suggestion had some merit.[263] Warden disagreed, stating:

> "LeMay was a practical sort of guy, and he looked at it and said, 'Would I rather have forty wings of the big ones, or one hundred wings of the smaller ones?' But then, he thinks, 'I am not going to get a hundred wings. I am only going to get forty wings, no matter what, because that is the way Congress operates. I would rather have forty wings with that one [the XB-52], than forty wings with this one [RAND's proposed smaller bomber].'"[264]

Despite the fact that SAC and AMC were against RAND's report, the Senior Officers Board supported it and additional studies on turboprop engines. According to Ed Wells of Boeing:

> "In connection with the B-52 program as well as the B-47, information prepared recently by RAND and by Air Force personnel appears to support further consideration of propeller turbine engines in airplanes of the B-47 and B-52 type. Since the use of propellers would definitely increase the range of either of these airplanes and might permit the accomplishment of missions at substantially

[262] Warden, Interview with Lori Tagg.
[263] Collins, *Cold War Laboratory*, p. 201.
[264] Warden, Interview with Lori Tagg.

> reduced gross weights it might be expected that increasing support will be obtained in Air Force circles for the use of propeller turbine airplanes, even though the shortcomings of propellers are well-recognized by most Air Force personnel."[265]

February 1950 **A supplemental agreement worth $2 million was added to Pratt & Whitney's contract to accelerate the development of the XJ57.** The manufacturer was to provide two more XJ57 engines for development test use; redesign of the engine wherever required as indicated by the full-scale engine testing and static load testing; and "first phase of an advanced engine development program aimed at increasing the thrust per unit frontal area."[266]

February 7, 1950 **Air Force Headquarters forwarded to AMC its decision regarding equipment for the engineering mockup of the reconnaissance version of the B-52.** The reconnaissance version would have two electronic intercept positions, a weather observer position, and provisions for 13 cameras (including a mapping camera, two night cameras, a movie camera, and a radar scope recording camera). The Air Force also requested that the bomb bay hold 24 T-86 photoflash bombs.[267]

In response, Boeing recommended the use of interchangeable pods or capsules in the bomb bay:

> "From a structural standpoint, the pod installation is desirable since the airframe is flexible and the compartment must be rigid to maintain pressurization. From an operational standpoint it would be desirable to employ a multi-purpose pod with the possibility of replacing it with a photo pod or a ferret pod for maximum effort missions in these phases of reconnaissance."[268]

March 23, 1950 **General Putt, Director of Research and Development in DCS/Materiel, approved AMC's recommendation that the two XB-52 aircraft in the 390,000-pound version (Model 464-67) with J57 engines be procured under the current contract.** AMC had supported their recommendation with cost estimates provided by Boeing. Eliminating the duplicate engineering required for using the J40 engines in one aircraft and J57 engines in the other balanced out the increased cost of the heavier airframes.[269] The Senior Officers Board also approved Boeing's Model 464-67 with the weight revisions.[270]

April 1950 **The Engineering Division reported that "firm configurations for all but a few basic systems [on the XB-52] have been established and the detail designs are approximately 30 percent completed.** Those systems which have not been fully established are the ATO system and portions of the tail armament systems. Approximately 20 percent of the tooling has been completed and some airplane parts have been fabricated. Approximately 90 percent of all GFP [Government Furnished Products] exclusive of engines is under procurement."[271]

April 22, 1950 **The possibility of using turboprop engines on the B-52 was still being argued in Air Force circles.** Presumably as a result of the January directive to the Aircraft Laboratory, Lieutenant Colonel Ernest N. Ljunggren, Warden's replacement as Chief of the Bombardment Branch, stated,

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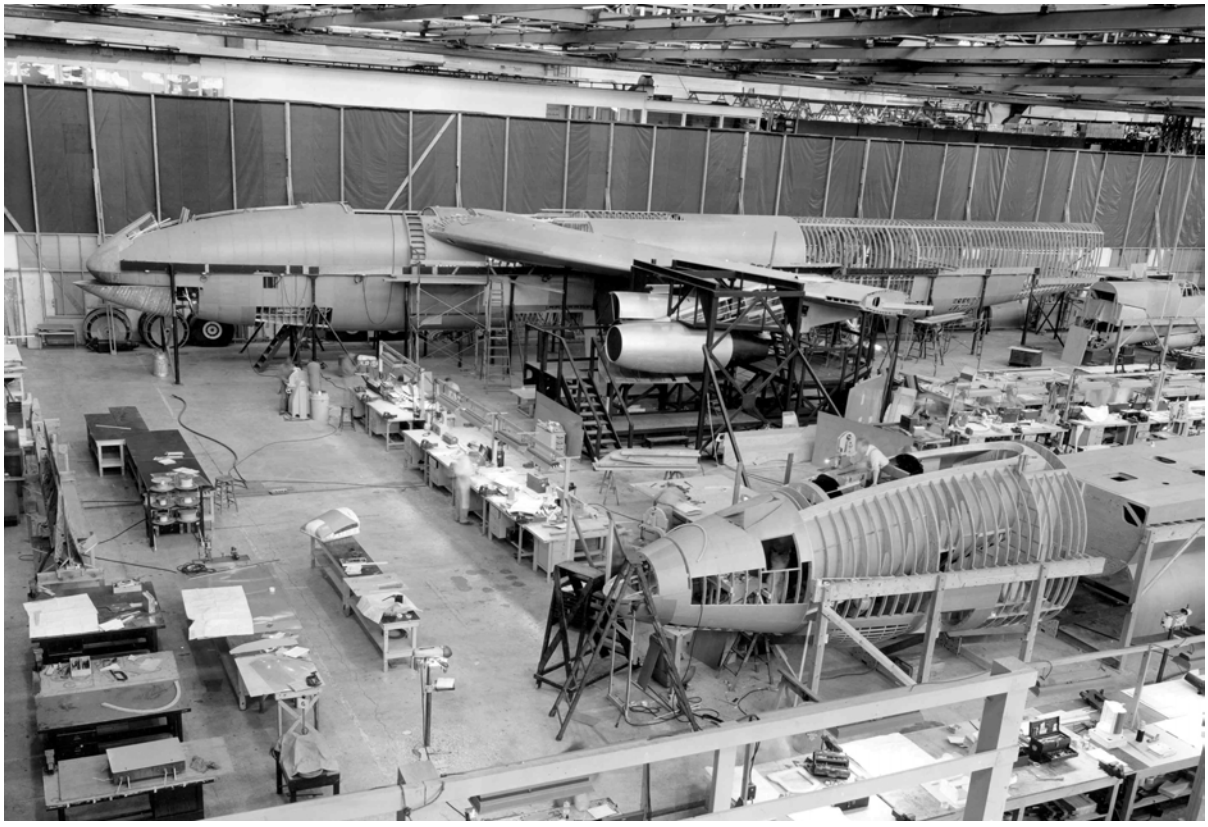
[265] Wells to Allen, 31 Jan 1950, in History of the B-52 Supplement, Jan – Dec 1950, pp. 23-25.
[266] Technical Accomplishments of the Power Plant Laboratory, Fiscal Years 1946-1951, p. 11.
[267] Col D. P. Graul, Chief, Electronics Branch, Engineering Division, Directorate of R&D, DCS/Materiel, to CG, AMC, Subj: Reconnaissance Equipment for RB-52 Airplane," 7 Feb 1950, in Greene, Sup. Doc. 37a.
[268] G. W. Hobson, Project Engineer, Reconnaissance Aircraft, Bombardment Branch, Aircraft and Guided Missiles Section, AMC, Memorandum Report on Conference to Establish Design Trend for RB-52 Airplane, 7 Aug 1950, in Greene, Sup. Doc. 45.
[269] MG Frederick M. Hopkins, Jr., Deputy to the CG for Operations, to Dir of Research and Development, Subj: Experimental XB-52 Program, 17 Feb 1950, in Greene, Sup. Doc. 40; MG D. L. Putt, to CG, AMC, 23 Mar 1950, in Greene, Sup. Doc. 40a.
[270] Greene, p. 15; Semiannual Report of the Aircraft and Guided Missiles Section, Engineering Division, AMC, 1 Jan – 30 Jun 1950, p. 1, AFMC/HO Archive.
[271] Engineering Division, Monthly Project Reports, Apr 1950, p. 20, Box 2018: Organizations/Engineering Division, Box 6 of 11, ASC/HO Archive.



XB-52 mockup, August 24, 1950. Representatives from the Pentagon and Wright Field conducted a number of mockup inspections before the XB-52 was actually constructed. (*Boeing*)

"…the range increase potentialities of the turbo prop power plant is [*sic*] in turn being considered as a possible retrofit installation probably in a pod type nacelle with the use of supersonic propellers."[272]

June 1950 The Engineering Division reported that 45 percent of the detailed design of the 464-67 was complete and a number of parts had been fabricated.[273]

June 1950 Following wind tunnel testing, the proposed all-moveable vertical tail on the XB-52 was changed to a conventional type rudder to solve flutter problems.[274]

June 6, 1950 A satisfactory mockup inspection of the power plant (engine nacelle) was held. "The power plant as mocked-up will insure that the XB-52 will fulfill the military characteristics for heavy bomber aircraft, dated 8 December 1947, which states the all-out range requirement as 8,000 statute miles (6,956 nautical miles)."[275]

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[272] Ljunggren, Presentation, 22 Apr 1950.
[273] Semiannual Report of the Aircraft and Guided Missile Section, Engineering Division, AMC, 1 Jan – 30 Jun 1950, p. 1, AFMC/HO Archive.
[274] Boeing, pp. 10, 39; Col R. L. Johnston, Chief, Aircraft and Guided Missiles Section, Engineering Division, to BG Lewis R. Parker, Chairman, Evaluation, Mock-up and Engineering Inspection Board for Bombardment, Subj: XB-52 Mock-up, 12 Jan 1951, in History of the B-52 Supplement, Box 3210: B-52 Case History, Box 10, ASC/HO Archive.
[275] Air Staff Summary Sheet, MG Francis H. Griswold, Assistant DCS/Materiel, 7 Jul 1950, in History of the B-52 Supplement, Jan – Dec 1950.

June 25, 1950 **The North Korean army crossed south of the 38th Parallel, the latitudinal border between North and South Korea, marking the beginning of the Korean War.** American naval and air forces were called into action two days later.

As was the case during World War II, budget restrictions were lifted and the primary factors preventing a B-52 production decision disappeared. Because the Senior Officers Board had not made a final recommendation in response to RAND's strategic bombing analysis that had caused so much tension among AMC, SAC, and Air Staff, the civilian analysts' arguments (for more rather than better airplanes) were no longer seriously considered.[276]

July 1950 **Air Force Headquarters reviewed and approved the findings of the mockup inspection board that the J57 engines could fulfill the 8,000 statute mile range requirement.** By this time, the J57 engine had completed approximately 250 hours of full-scale testing.[277]

August 3, 1950 **A conference was held at AMC and attended by representatives of Air Force Headquarters, SAC, and Boeing to review the design studies of the reconnaissance version of the B-52 (known as Boeing Model 464-108) and "to establish the trend of design for further and more detailed studies."** The attendees agreed to further development of the multi-purpose capsule, as recommended by Boeing, as well as studies on separate photo and ferret pods.[278]

August 25, 1950 **Convair proposed a modification of the straight-wing, propeller-driven B-36 into a swept-wing, jet-propelled version to compete against the B-52.** Originally the B-36G, the designation of Convair's proposed aircraft was changed to YB-60 in mid-1951 after AMC authorized conversion of two B-36Fs into the jet version. Convair planned to power its new bomber with eight Pratt & Whitney J57 engines. (Also see October 31, 1951 and April 18, 1952)

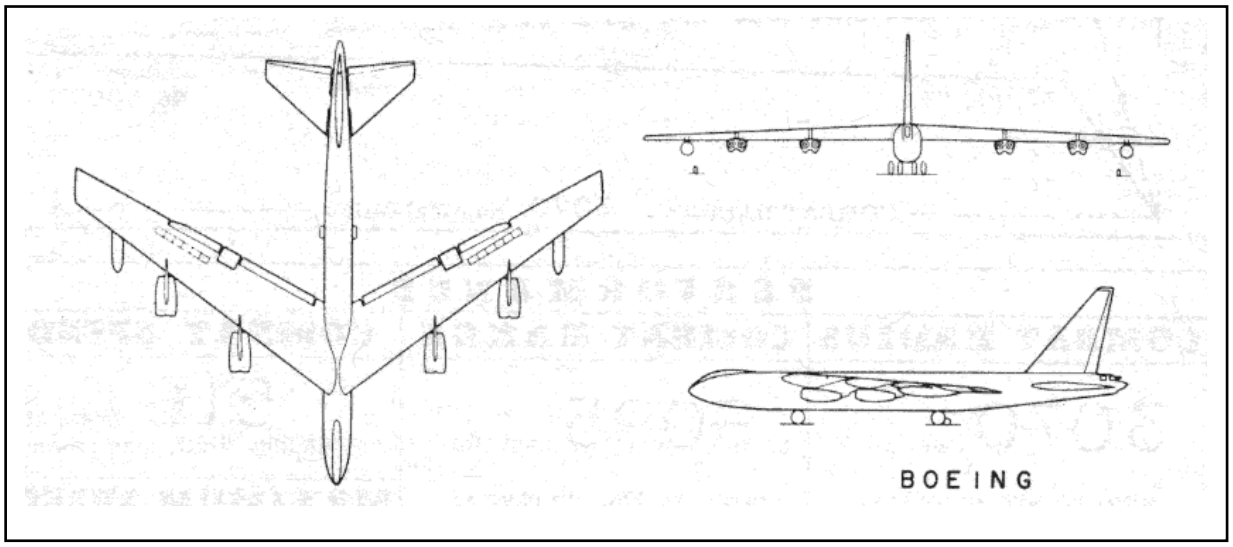
October 1950

The Engineering Division reported favorably on the progress of the XB-52 program:

> "Boeing has completed about 60 percent of the engineering and is continuing construction of the airplane. …A dummy turret will be installed in the experimental airplane with space and structural provisions for the subsequent installation of the A-3 fire control system which is expected to be late in delivery.…
>
> "Guarantee performance of .84 SFC [specific

The YB-60 was originally designated the YB-36G because it was an all-jet swept-wing modification of the B-36F. Following flight tests through 1952, the Air Force cancelled the program as the B-52 showed better performance and growth potential.

[276] Collins, *Cold War Laboratory*, p. 209.
[277] Technical Accomplishments of the Power Plant Laboratory, Fiscal Years 1946-1951, p. 23; Greene, p. 28.
[278] Hobson, Memorandum Report on Conference to Establish Design Trend for RB-52 Airplane, 7 Aug 1950, in Greene, Sup. Doc. 45.



Three-view diagram of the XB-52 dated October 6, 1950. By this time, the locations of the engine nacelles had been determined through wind-tunnel testing.

fuel consumption] at 8700 pounds thrust was obtained during a recent unofficial 50-hour endurance test of the [J57] P-3 model. Pratt and Whitney has started another unofficial 50-hour endurance test using improved parts."[279]

October 2, 1950 Boeing presented AMC with a Phase I Study Proposal for the XRB-52, Boeing's Model 464-108, at an estimated cost of $415,000 to $468,000.[280]

October 25, 1950 Dissatisfied with the current equipment, SAC forwarded to AMC its recommendations for defensive systems on the B-52. Major General Thomas S. Power, Deputy Commander of SAC, argued that the chosen defensive armament system, the A-3, "is not consistent with recommendations for optimum armament on this airplane as proposed by the various weapons advisory groups, nor with the military characteristics for future armament systems…." SAC commanders were convinced that all defensive armament for the B-52 should be interim pending the transition to air-launched missiles, but with the time delay involved until this transition, high priority was needed to develop reliable defensive armament. They recommended increasing the number of guns in the tail turret from two to four; providing simultaneous search and track radar for night and bad weather operations; installing reliable IFF (Identification Friend or Foe) equipment; and pursuing the development of 25mm and 30mm cannon for the bomber "to bridge the gap between conventional armament and air-launched missiles."[281]

November 1950 After the Senior Officers Board inspected the mockup and reviewed the overall program, Boeing proposed a production program.[282]

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[279] Engineering Division, Monthly Project Reports, Oct 1950, p. 41, in Box 2018: Organizations/Engineering Division, Box 6 of 11, ASC/HO Archive.
[280] Boeing Airplane Company to CG, AMC, Subj: Phase I Study Proposal, XRB-52 Photo-Reconnaissance Airplane, 2 Oct 1950, in Greene, Sup. Doc. 54.
[281] MG Thomas S. Power, Deputy Commander, SAC, to Dir of Requirements, HQ, USAF, Subj: B-52 Defensive Capability, 25 Oct 1950, in Greene, Sup. Doc. 55.
[282] Boeing, p. 5.

November 17, 1950 AMC instructed Boeing to determine the cost and time factors involved in converting the B-52 to carry the Bell Rascal air-to-surface stand-off missile (MX-776).[283] Boeing estimated that it would cost an additional $50,000 per airplane to manufacture 40 B-52s to carry the Rascal missile and its associated AN/APQ-24 equipment. Boeing leaned toward making this change in production. They estimated that the cost of converting production B-52s with the K-3 bombing equipment into Rascal carriers "appears to be large, even in quantity, and is not recommended."[284]

1951

January 9, 1951 Air Force Headquarters initiated the production program for the XB-52. Procurement Directive 51-120 granted AMC the authority to use fiscal year 1951 funds for pre-production costs. Of the $35 million authorized, $10 million was slated for implementation of airframe production by Boeing and $25 million was slated for procurement of long lead-time government furnished products (GFP).[285]

February 1951 The Engineering Division reported that 35 percent of the structures of the two experimental B-52s was complete.[286]

February 1, 1951 AMC received the results of a study on B-52 production, conducted by an outside consultant, P. N. Jansen. Jansen stressed that in order to meet production schedules of four airplanes per month, the Boeing-Wichita facility should be used:

> "The advantages of putting the B-52 in Wichita are many. The B-47 and B-52 are of the same structural design, requiring the same manufacturing techniques. The manufacturing equipment now in Wichita would practically be ready-made for the B-52 with very few additions. Over and above a great savings in time and money, it would avoid a lot of initial confusion and grief usually encountered in opening a new facility….
>
> "Right now such a move may be difficult to see with Wichita only in the initial stages of the B-47B production. However, from this point on, the picture should change and with approximately another two years to go, the B-52 for Wichita idea may have merit."[287]

February 14, 1951 In response to Procurement Directive 51-120, AMC issued an initial procurement contract—Letter Contract AF 33(038)-21096—to Boeing for 13 B-52As. The first production aircraft was scheduled for delivery in April 1953.[288] These airplanes were initially planned as "development vehicles in order to complete the flight test of the basic aircraft as expeditiously as possible. This approach is considered advantageous…and is expected to result in the earliest availability of tactically suitable aircraft."[289]

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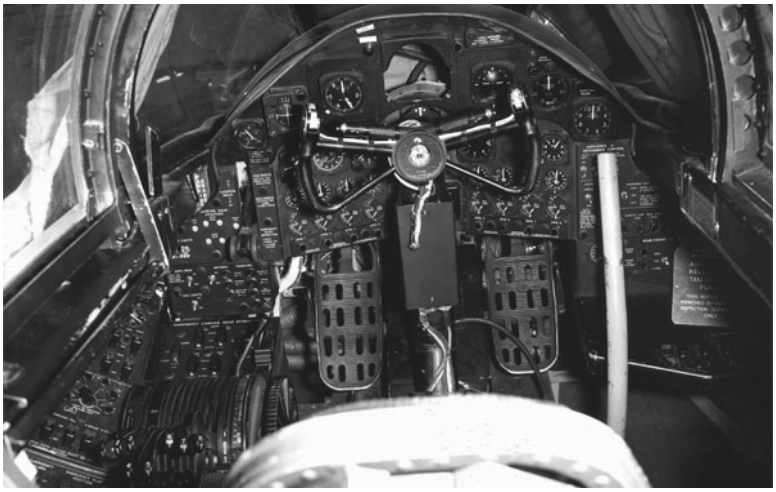
[283] Col Carl F. Damberg, Chief of Aircraft and Guided Missiles Section, Engineering Division, to Boeing, 17 Nov 1950, in History of the B-52 Supplement, Jan – Dec 1950, p. 366.
[284] J. B. Connelly, Dir of Contract Administration, Boeing, to CG AMC, 18 Dec 1950, in History of the B-52 Supplement, Jan – Dec 1950, p. 370.
[285] AMC, Directorate of Procurement and Industrial Planning, Procurement Division, Aircraft Section, Bombardment Branch, Semiannual Report, B-52 Program, 1 Jan – 1 Jul 1951, p. 1, in AFMC/HO Archive.
[286] Semiannual Report of the Aircraft and Guided Missiles Section, Engineering Division, AMC, 1 Jul – 31 Dec 1950, p. 3, ASC/HO Archive.
[287] P. N. Jansen, *Preliminary Production Study, B-52*, 1 Feb 1951, p. 5, in Box 3211: B-52 History Supplement, Box 11, ASC/HO Archive. Boeing's Wichita facility was chosen as the second source for B-52 production in September 1953.
[288] Knaack, pp. 206, 219.
[289] Memorandum, Subj: B-52A and XRB-52 Mockup Military Characteristics dated 3 Oct 48 established characteristics for a Strategic Reconnaissance Aircraft, Appendix VII-1cc to Weapons Systems Division, Memorandum Report on Conference on RB-52 Airplane Configuration and Equipment Requirements, 20 Sep 1951, in Greene, Sup. Doc. 73, p. 66.

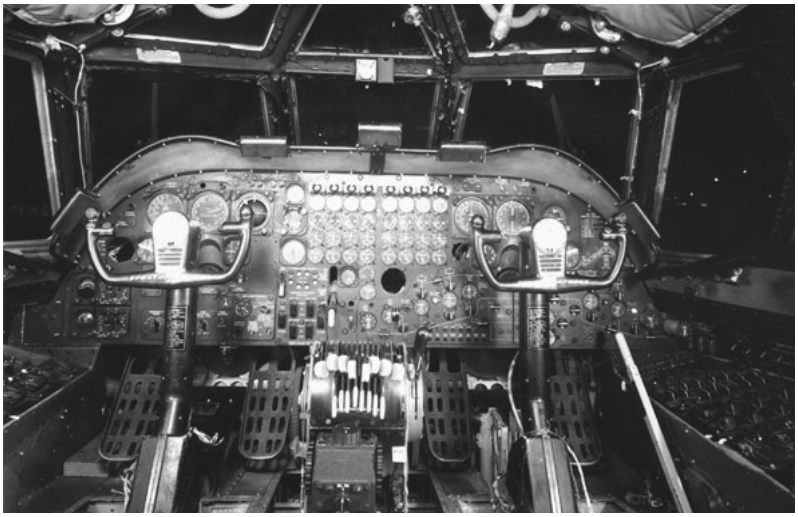
March 1-2, 1951 A USAF Bomber Mock-Up Board Meeting was held at Boeing's Seattle plant to determine the configuration of a production B-52. Members of the board were astounded when SAC presented some unexpected requirements, personally requested by General LeMay, including changing the seat arrangement from tandem to side-by-side, adding three crew members to the forward compartment, and converting the hydraulic system to an electrical system. Previous meetings of the board had led to recommendations for a production B-52 very similar to the XB-52 configuration. However,

> "…[i]f the proposed changes by SAC are accepted, the B-52 airplane…will then become another airplane. It is expected that a meeting will be held at the request of SAC with AMC personnel to arrive at a more satisfactory configuration from the operational standpoint; however, the present configuration in the airplane has been approved time and time again by SAC personnel."[290]

March 8, 1951 The experimental J57 engine made its first flight, mounted under the wing of a B-50 bomber. The first prototype of the engine was delivered to Boeing three months later.[291]



The XB-52 was designed with a tandem (fighter-like) cockpit, as requested by SAC in February 1948. Shown here, the cockpit had eight engine throttles to the left of the pilot.



In 1951, General LeMay surprised the Air Force Mockup Board when he requested a side-by-side cockpit for the B-52. While both the XB-52 and YB-52 retained the tandem cockpits, all production B-52s had the side-by-side arrangement. Engine throttles were located between the pilot and copilot seats. (*United States Air Force Museum, Leonard Sommer Collection*)

[290] Lt Col J. L. Murray, Engineering Division, Record of Official Contacts, Subj: Meeting of USAF Bomber Mock-up Board at Boeing Airplane Company, 9 Mar 1951, in Greene, Sup. Doc. 61.
[291] St. Peter, p. 178.

March 14, 1951 General Orval Cook, Director of Procurement and Industrial Planning, informed Boeing that the B-52 airplane had first priority in receiving the J57 engine:

> "Contractor is advised that it will be the Air Force policy to give first priority for J-57 Engines to B-52 Airplanes. In the event that sufficient J-57 Engines cannot be provided for the swept-wing B-36 [YB-60] without detriment to the B-52 Program, the B-36 will utilize some other engine."[292]

March 19, 1951 The Air Force issued Letter Contract AF 33(038)-22706 with Boeing for Phase I studies and a mockup of the RB-52. The mockup inspection was scheduled for September 1951:

> "A proposal is being forwarded to Hqs USAF to fabricate a service test model of the reconnaissance version through modification of one of the early B-52A's. A determination of the airplane to be selected for modification will be withheld until such time as the contractor's studies indicate the extent of the modifications which will be required. Generally, an RB-52 is anticipated to be flight tested in 1954."[293]

March 19-20, 1951 A conference was held at AMC to determine the configuration of the B-52A airplane. The SAC requests from March 1 were discussed in addition to several proposals from Boeing, including extended wing-tips for increased range, a rear pressure compartment for the gunner with a

View of the gunner's compartment and the four guns on the B-52. The B-52B/C/D/E/F/G were armed with four 20mm or .50-caliber guns. On the G model, the gunner was moved to the forward cabin with the rest of the crew. (*United States Air Force Museum Photo Collection*)

Two airmen load the guns at the rear of the B-52. On the H model, the four .50-caliber guns were replaced with a single 20mm M-61 cannon. (*United States Air Force Museum Photo Collection*)

[292] Gen O. R. Cook to Boeing, Subj: XB-52 and B-52A Airplane, J-57 Engines, 14 Mar 1951, in History of the B-52 Supplement, Box 3210: B-52 Case History, Box 10, ASC/HO Archive.

In 1951, the B-52 program, now called the B-52 Joint Project Office, moved to new offices in Building 15, Area B.

pressurized tunnel to the front compartment, water injection for engines together with ATO units, and a 21-inch extension of the forward compartment to accommodate an eight-man crew as opposed to the earlier five-man crew.

Stating that some characteristics were necessary and others were simply desirable, General LeMay insisted "he did not want the delivery to be delayed even one hour, and even indicated that some of the desirable features could be eliminated in order that no delay might occur." The seating arrangement, however, was necessary "to permit sufficient cooperation and coordination between the two pilots."

Boeing was directed to study the weight, range decrease, cost, and time factors involved in making the changes with the results to be forwarded to the Production Board for recommendations and final approval by Air Force Headquarters.[294]

March 31, 1951 **During a conference with the Arma Corporation in Brooklyn, New York, it was determined that the A-3 fire control system and turret with two .50-caliber guns would not be available until June 1952.** A four-gun turret would not be available until August 1952. Although the Armament Laboratory desired installation of a manual turret in one of the XB-52s for flight tests, it determined that this was not feasible given Arma's manpower and facility limitations. A decision was reached that neither XB-52 would incorporate a functional turret.[295]

April 1951 **A joint project office (JPO) for the B-52, the first of its kind, was activated to insure that the weapon system, including airframe and all of its components, was well-integrated.** This brought together all personnel, engineering and procurement, for the B-52 program in a single location at what would become the Wright Air Development Center (WADC) (as of June 8, 1951). Previously, two project offices had been in existence, one for the experimental aircraft in the Bombardment Branch of the Engineering Division and the other for the production aircraft in the Procurement Division. With the increasing complexity of aircraft, joining the two autonomous offices into one created a closer working relationship between all personnel engaged with a particular program. Organizationally, the B-52

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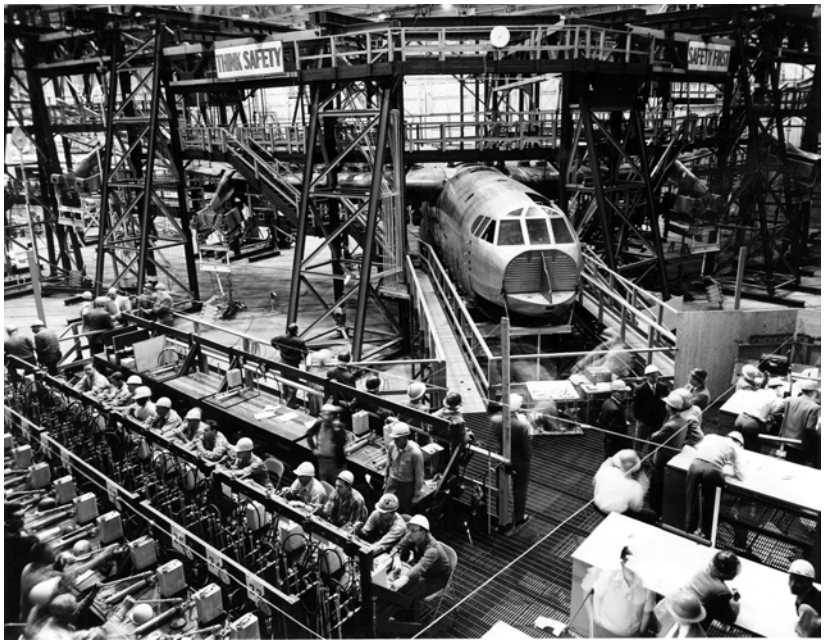
[293] Maj Shaffer, Presentation to AMC's Commander's Conference: General Production Aspects of the B-52, 19-20 Jun 1951, in History of the B-52 Supplement, Box 3210: B-52 Case History, Box 10, ASC/HO Archive.

[294] A. Ward Knisley, Memo for Record, Subj: Notes on B-52A Configuration Conference, 22 Mar 1951, in Greene, Sup. Doc. 63; J. B. Connelly, Dir of Contract Administration, Boeing, to CG, AMC, Subj: Prototype Installation of Extended Wing Tips on an XB-52 Airplane, 21 Mar 1951, in History of the B-52 Supplement, Box 3210: B-52 Case History, Box 10, ASC/HO Archive; Col G. F. Keeling, Chief, Aircraft and Missiles Section, Procurement Division, to Boeing, Subj: B-52A Airplane Configuration Studies, 21 Mar 1951, in History of the B-52 Supplement, Box 3210: B-52 Case History, Box 10, ASC/HO Archive.

[295] Lt Col J. L. Murray, "Visit to Arma Corporation on 28 Mar 1951," 31 Mar 1951, in Greene, Sup. Doc. 65.

JPO was within the Bombardment Branch of the Aircraft Section, Weapons Systems Division, WADC, Air Research and Development Command (see Appendix 1, Chart 9). Its offices were located on the second floor of Building 15. Lieutenant Colonel James L. Murray was the B-52 Project Officer and Colonel Ernest N. Ljunggren was Chief of the Bombardment Branch.[296]



The wing-bending phase of the B-52 static test program in the Boeing Flight Center, Seattle. The men at lower left are operating the hydraulic pumps that control the strain applied to the wings. (*United States Air Force Museum Photo Collection*)

May 1951

The B-52A mockup inspection was held in Seattle.[297] It included an inspection of the side-by-side cockpits as requested by General LeMay (see March 1-2, 1951). The Air Force originally contracted with Boeing to make the change from the tandem to side-by-side cockpit on the fourteenth production aircraft. Delays in beginning the production program, attributable to the "weldment program and the engine procurement situation," however, led AMC to direct Boeing to make the change on the first production B-52A.[298]

June 13, 1951 **The Air Force officially redesignated the second XB-52, AF serial number 49-231, as a production prototype.** Boeing was authorized to install tactical equipment in this airplane, now called YB-52.[299]

August 9, 1951 **AMC requested that Boeing negotiate with Hughes Aircraft Company on the feasibility of installing the Hughes AIM-4 Falcon air-to-air missile as defensive armament on the B-52.**[300]

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[296] Colonel Robert L. Johnston was the chief of the Weapons Systems Division from April 1951 to July 1952, at which time Colonel Victor R. Haugen took over. In September 1952, Weapons Systems Division became a part of the Deputy for Operations at WADC. WADD Historical Branch, "Resume of WSPO Evolution, 1945-1960," 29 Dec 1959, in ASC/HO Archive; WADC, Organizational Charts.

[297] Rothman, *Acquisition Milestones,* p. 79; B-52 Weapon System Survey, 6-18 Feb 1955, Office of the Inspector General, HQ AMC, Vol. 1 of 2, 9 Mar 1955, in Box 3205: B-52 Bomber Files, Box 5, ASC/HO Archive.

[298] Boeing, p. 49; Col Joe P. Walters, Contracting Officer, AMC, WPAFB, to Boeing, Air Mail, Subj: B-52A Airplanes, Side-by-side Pilot Seating, 22 Aug 1951, in History of the B-52 Supplement, Box 3210: B-52 Case History, Box 10, ASC/HO Archive.

[299] "Contract Changes to Acceptance Schedules, B-52 History," Nov 1962, p. 3, in Box 3212: B-52 History Supplement, Box 12, ASC/HO Archive; Boeing, pp. 10, 42.

[300] Col G. F. Keeling, Chief, Aircraft Section, Procurement Division, WADC, to Boeing, Subj: B-52 Airplane, Defensive Armament, 9 Aug 1951, in History of the B-52 Supplement, Box 3210: B-52 Case History, Box 10, ASC/HO Archive. The AIM-4 Falcon (originally GAR-1) manufactured by Hughes Aircraft Company was initially contracted for in 1947 as the XF-98 pilotless interceptor. The Falcon missile became the world's first operational, air-to-air guided weapon in 1955, and by 1963, the Air Force had accepted approximately 48,000 Falcons. Falcons were never used to arm the B-52, although they were used on a number of the Air Force's fighters.

The Falcon, originally known as the XF-98 pilotless interceptor, became the world's first operational air-to-air guided weapon in 1955.

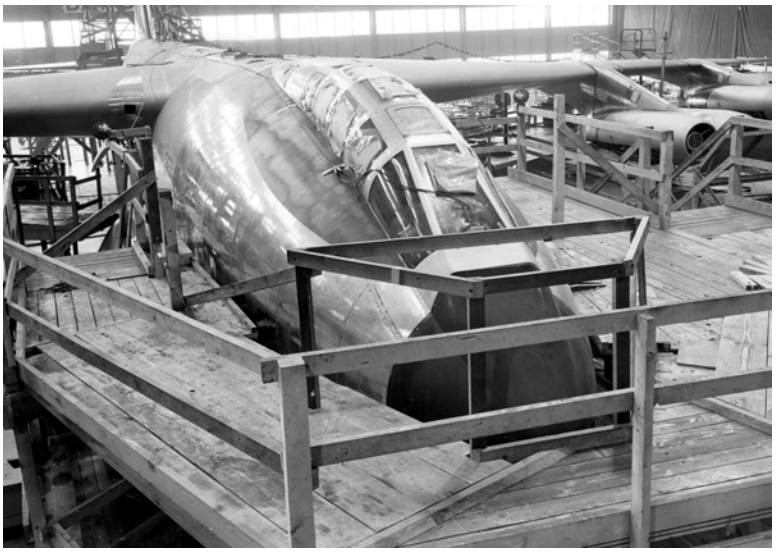
August 29-30, 1951 Representatives of Air Force Headquarters, ARDC, SAC, Air Weather Service, AMC, and Boeing attended a conference at WADC to firm up RB-52 plane and pod configurations. Official requirements now stated that all B-52A aircraft were to be built as general-purpose reconnaissance airplanes. Conclusions of the conference included the phase-in of two pods: a multi-purpose pod available in mid-1953 and an interim ferret pod available later the same year. A major redesign of the pod was expected to occur once new reconnaissance equipment was available. This latter pod would not be available for installation until 1955. The special photo pod and night photo pod requirements were cancelled when it was determined that the capabilities of the multi-purpose pod fulfilled SAC's requirements. SAC insisted that all pod configurations were required to readily "facilitate bomber convertibility." At this time, it was realized that the RB-52, despite its high intelligence data gathering capability per sortie, would have certain operational limitations, requiring it to be "supplemented by other Reconnaissance/ Intelligence Systems [RB-36 and RB-47] in the overall strategic weapons program for this time period [1954-1958]." These limitations stemmed primarily from the desire to protect the airplane from high attrition rates, thus not allowing the airplane to operate in heavily defended areas.[301]

Artist's conception of the RB-52C, with removable reconnaissance pod aft of the wings. The C model reconnaissance version had higher thrust engines than the B models and carried extra fuel in underwing drop tanks.

September 25, 1951 Colonel Whitmell T. Rison, Director of Procurement and Production Engineering in the office of the DCS/Materiel, did not concur in AMC's recommendation to continue studies of extended wing tips on the B-52. Boeing's preliminary conclusions had indicated that a 19 percent increase in radius was possible with the wing tips, but they needed to conduct more exhaustive wind tunnel tests to determine feasibility. The entire program was estimated to cost $4 million, including wind tunnel studies, fabrication and installation on a B-52A, and flight tests. In May 1951, AMC had considered installation of the extended wing tips on the B-52 mandatory if it was to meet SAC's requirements for range.[302] Rison, however, based his decision "on the fact that the B/RB-52 requires tanker support even

[301] Weapons Systems Division, WADC, Memorandum Report on Conference on RB-52 Airplane Configuration and Equipment Requirements, 20 Sep 1951, in Greene, Sup. Doc. 73.
[302] MG Orval R. Cook, Dir, Procurement and Industrial Planning, to Dir of Procurement and Production Engineering, HQ USAF, Subj: B-52A Airplanes, Extended Wing Tips, 24 May 1951, in Greene, Sup. Doc. 70.

with the extended wing tips in order to reach the minimum acceptable radius." A similar program for the B-47, he reasoned, might also be applicable to the B-52 program.[303]



XB-52 canopy during manufacturing, October 25, 1951. The XB-52 would roll out of the factory about one month later. (*Boeing*)

October 3, 1951

Air Staff directed that all aircraft "will be of the RB-52 configuration as there is no requirement for a B-52." This directive seems to stem from SAC's wishes. In early 1951, General LeMay voiced his opinion that development of a long-range, high-speed aircraft, "such as the RB-52, capable of operating alone over highly defended enemy areas in the performance of the reconnaissance mission," was "perhaps even more important" than modernizing SAC's intercontinental bomber forces.[304] Then again, in June 1951, SAC proposed a B-52 with a primary reconnaissance mission, but easily convertible to a bomber configuration if necessary. As a result of the directive, plans for easily removable reconnaissance pods designed for the B-52's bomb bay continued. So as not to delay the delivery of the aircraft, the first six production aircraft were to be delivered as standard bombers; the seventh through twenty-fifth were to be delivered with provisions to install the reconnaissance capsule under retrofit programs. The twenty-sixth aircraft and above were to be delivered with the capsule installed.[305]

October 31, 1951 The controversy over J57 engine priorities, for either the XB-52 or YB-60, continued. The YB-60 was nearing its scheduled flight test to determine the soundness of the B-36F modifications. In September, Major General Carl A. Brandt, Assistant DCS/Materiel, had reversed Major General Cook's March 14, 1951, directive giving the XB-52 priority. Brandt believed instead that the YB-60 had priority for delivery of J57 engines because the modified B-36s would have "many advantages, from the standpoint of time and cost, over the B-52 program." He indicated that "[i]f the soundness of the idea is considered satisfactory, possibly the entire B-36 fleet may be converted [into] a B-60 configuration."[306]

Lieutenant Colonel James Murray, the B-52 project officer at WADC, protested that, because Convair was only testing the airframe modifications of the B-36/B-60, it should use J47 engines and leave the J57s to the B-52 program. Major General Frederick R. Dent, Commander of WADC, also requested Air Force Headquarters settle the engine priority controversy between the B-52 and B-60 on the basis of which would be the more valuable weapon to the Air Force. Dent stated:

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[303] Col Whitmell T. Rison, to CG, AMC, Subj: B-52 Airplanes, Extended Wing Tips, 25 Sep 1951, in Greene, Sup. Doc. 70a.

[304] Knaack, pp. 119-221; AMC, Directorate of Procurement and Industrial Planning, Procurement Division, Bombardment Branch, Semiannual Report, B-52 Program, 1 Jul 1951 – 1 Jan 1952, p. 83, AFMC/HO Archive. This decision was reversed in January 1955 and the primary mission of the airplane from then on was bombardment.

[305] XRB-52/B-52A Stratofortress, Reconnaissance and Side-by-Side Cockpit Mockup Inspection Report, Dec 1951, in Box 3211: B-52 History Supplement, Box 11, ASC/HO Archive; Weapons Systems Division, WADC, Memorandum Report on Conference on RB-52 Airplane Configuration and Equipment Requirements, 20 Sep 1951, in Greene, Sup. Doc. 73, p. 67.

[306] Greene, pp. 38-39.

> "Naturally I want to get my '52's flying as quickly as possible. On the other hand, if they decide the retrofit program [of the B-60] has priority over the production program [of the B-52], that's perfectly fine with me. We'll play it that way."[307]

The engine allocation issue was finally settled on November 5, when Generals Putt (now Assistant DCS/Development), Dent, and Cook (Director of Procurement and Industrial Planning, AMC) agreed that the B-52 would have priority on engine allocations through December 1951. At that time, the B-60 program would begin to receive small numbers of J57 engines.[308]

Murray, however, was particularly concerned that the Air Council (previously the Senior Officers Board) wanted to evaluate the B-60 against the B-52. He stated, "The evaluation is allegedly to decide whether the B-52 or the B-60 is to be produced beginning in January 1955…." Murray recommended "that immediate action be taken by [WADC's] Weapons Systems Division to insure that the B-60 meets the same design criteria and standards that the B-52 has been required to meet…" and "that aggressive action be initiated to insure that the evaluation to be conducted is made using the same set of ground rules for both aircraft."[309] (Also see August 25, 1950 and April 18, 1952)

Frederick R. Dent, Jr., served as a test pilot in the 1930s. Following the war, he was Chief of the Engineering Branch, Materiel Division, at Air Force Headquarters in Washington, D.C. He returned to Wright Field in 1946, serving in a variety of positions, including Chief of the Equipment Laboratory and Chief of the Engineering Division, until 1950. When the Wright Air Development Center was activated in 1951, Dent served as its first commanding general.

November 29, 1951

The XB-52 (Model 464-67, serial number 49-230) rolled out of the factory. To speed up the production schedule of B-52As, the XB-52 lacked many accessory items that were not needed for engine and ground tests. In particular, Boeing was waiting for the General Electric pneumatic system chosen to operate all of the accessories on the airplane. Once the system was installed, ground tests began. Shortly thereafter, the pneumatic system failed causing a small explosion that damaged the wing trailing edge. The XB-52 required extensive repairs, delaying its maiden flight. Rescheduled for mid-March 1952, the first flight of the XB-52 would not take place until October 1952.[310]

Following final assembly of the XB-52, it was covered with tarps for security purposes. (*Boeing*)

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[307] Quoted in Greene, p. 39.
[308] J. L. Murray, Record of Official Contact, 8 and 9 Nov 1951, in History of the B-52 Supplement, Box 3210: B-52 Case History, Box 10, ASC/HO Archive.
[309] *Ibid*.
[310] Col R. L. Johnston, Chief, Weapons Systems Division, Disposition Form, Subj: Status of Pneumatic System for XB-52 Airplanes, 13 Nov 1951, in History of the B-52 Supplement, Box 3210: B-52 Case History, Box 10, ASC/HO Archive.

The XB-52 was rolled out its hangar at Boeing in complete secrecy in November 1951. The vertical tail of the big bomber had to be folded down to get out of the hangar. (*Boeing*)

December 12, 1951 A mockup inspection was held at Boeing's Renton, Washington, plant. This inspection was specific to the RB-52 with the multi-purpose reconnaissance capsule, in addition to the side-by-side pilot's compartment for the B-52A. The 121 "requests for alteration or study" ranged from relocating various equipment for ease of operation and labeling switches and panels to assist during maintenance and operations, to consideration of the future installation of additional equipment and deletion of existing equipment.[311]

1952

January 24, 1952 Colonel Robert L. Johnston, Chief of the Weapons Systems Division at WADC, recommended that the B-52 incorporate probe-and-drogue in-flight refueling equipment instead of the boom. The probe-and-drogue method had been developed in Great Britain in the latter part of the 1940s and was available for use in September 1950. Using a flexible hose unreeled from the tail, bomb bay, or wing tips of a tanker, the new system could offload 600 gallons of fuel per minute at speeds up to 300 mph. Johnston's recommendation came in light of the fact that refueling B-52-type aircraft with a boom-equipped KC-97 tanker was "considered marginal." Proposals to convert a B-36 to a probe-and-drogue tanker provided further impetus to install the equipment on the B-52:

> "It is the opinion of this Headquarters that the probe and drogue system will prove superior to the 'Flying Boom' system. Since the anticipated B-36 tanker will incorporate the superior probe and drogue system, will have the necessary performance, and will be available by the time the B-52

[311] Boeing, p. 6; XRB-52/B-52A Stratofortress, Reconnaissance and Side-by-Side Cockpit Mockup Inspection Report, Dec 1951, in Box 3211: B-52 History Supplement, Box 11, ASC/HO Archive.

A new method of aerial refueling, the probe-and-drogue shown here on a KB-50D, had been developed in Great Britain in the late 1940s. Although the Air Force considered installation of this method on the B-52, it settled on the Flying Boom for its bombers.

becomes operational, it is proposed that the air-to-air refueling requirements for the B-52 be revised to incorporate the probe and drogue system."[312]

In response to WADC's recommendation, Colonel Harry J. Sands, Jr., Director of Aircraft in the Office of the Deputy for Development, ARDC, cited tests of the probe-and-drogue equipped B-36 at Edwards Air Force Base ongoing since the fall of 1951. Sands postponed the decision to revise the B-52 in-flight refueling equipment until completion of the B-36 tests.[313]

February 1952 AMC issued a letter contract to Boeing for the design and fabrication of one multi-purpose capsule and the modification of one B-52 airplane [Model 464-201] to accommodate this capsule. The estimated cost for the full development of the multi-purpose pod, including Phase I and II studies, modification of one airplane, and installation of the pod, was $5.4 million. The first multi-purpose pod was scheduled for completion in November 1954.[314]

March 15, 1952 The YB-52 (Model 464-67, serial number 49-231) rolled out of the factory.[315]

March 21, 1952 Colonel Joe P. Walters, Chief of the Bombardment Branch in the Aircraft Section, Weapons Systems Division, WADC, requested the authority to amend Boeing's letter contract to establish the procurement of B-52s in definite quantities by model. The Air Force contracted for three B-52As (non-convertible); 10 B-52B (or RB-52B) basic carrier airplanes with provisions for multi-purpose capsules; 10 bomber kits for B-52Bs; and 10 multi-purpose capsules (including one prototype) for

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[312] Col R. L. Johnston, Chief, Weapons Systems Division, WADC, to CG, ARDC, Subj: In-Flight Refueling Provisions for B-52 Airplane, 24 Jan 1952, in Box 3211: History of the B-52 Supplement, Box 11, ASC/HO Archive.

[313] Col H. J. Sands, Jr., Dir of Aircraft, Office, Deputy for Development, to CG, WADC, Subj: In-Flight Refueling Provisions for B-52 Airplane, 25 Feb 1952, in Box 3211: History of the B-52 Supplement, Box 11, ASC/HO Archive. The production B-52s were equipped with flying boom aerial refueling equipment, but the probe-and-drogue was installed on several of the Air Force's and Navy's fighters.

[314] Boeing, p. 53; Col R. L. Johnston, Chief, Weapons Systems Division, WADC, to HQ ARDC, Subj: RB-52 Airplane Configuration, 14 Feb 1952, in Box 3211: History of the B-52 Supplement, Box 11, ASC/HO Archive.

[315] Rothman, *Acquisition Milestones,* p. 79.

The YB-52 took off for its first flight on April 15, 1952, six months before the XB-52.

Boeing's test pilot Tex Johnston, shown here with President Dwight D. Eisenhower, was the first pilot to fly the YB-52. (*United States Air Force Museum, Orville Long Collection*)

Lieutenant Colonel Guy Townsend, of the Bomber Flight Test Section at WADC, served as copilot during the YB-52's first flight.

The YB-52 underwent numerous years of testing before being retired and given to the United States Air Force Museum in 1958. It was burned in a Fire Department exercise in the early 1960s.

retrofit to the B-52Bs. The Procurement Committee under the Director of Procurement and Production approved this amendment on March 25, 1952.[316] It should be noted that the RB-52 program had been contracted separately under AF 33(038)-22706 in March 1951. The program was later brought under the original B-52A production contract, AF 33(038)-21096, "[d]ue to the impetus of the production program and the lack of sufficient funds to adequately finance the XRB-52 airplane under [Contract 22706]." Funds available for the RB-52 were incorporated into the B-52A contract.[317]

April 15, 1952 The YB-52, equipped with prototype J57 engines, made its first flight from Boeing Field in Seattle. Boeing's test pilot, A. M. "Tex" Johnston, served as pilot. Lieutenant Colonel Guy M. Townsend, in the Bomber Flight Test Section of the Flight Test Division, WADC, was the copilot. Reports indicated that the flight, which lasted just over two hours, was "eminently satisfactory," despite the fact that the aircraft was restricted in altitude due to low power surge. Other deficiencies noted were spoiler buffet, leaking fuel cells, improperly retracting landing gear, and marginal lateral control at slow speeds.[318]

April 18, 1952 After being delayed nearly six months by the shortage of J57 engines, the YB-60 made its first flight. Problems encountered during the flight test program over the next year led the Air Force to cancel the program to convert B-36s into B-60s. Instead, continuation of the B-52 program was favored because it had better performance and growth potential.[319] (Also see August 25, 1950 and October 31, 1951)

May 13, 1952 WADC received approval to amend Boeing's letter contract to include the production of seven additional B-52B aircraft for a total of 20 aircraft (including the three B-52As), seven bomber kits, and seven multi-purpose pods. The total cost for the procurement of 20 B-52s was estimated at $375 million.[320] The delivery schedule for the airplanes called for one per month between January and April 1954, stepping up to two per month in May. The final airplane would be delivered in December 1954.[321]

June 19, 1952 The B-52 program was placed in the "S" category on the Department of Defense's "relative urgency" list of critical military end products called "BRICKBAT." This meant that "delivery [had to] be made on time regardless of what other order it displace[d]—except another 'BRICKBAT'." Boeing informed all of its suppliers and subcontractors of the importance of this directive:

> "When you encounter or anticipate difficulties in connection with one of our or your orders for this program, which are beyond your ability to control or resolve, you are entitled to avail yourselves of the special expediting assistance provided for in the Air Materiel Command's Director Office Instruction No. 70-161 dated 6 March 1952. …You and your suppliers, down to the remotest source, must use 'BRICKBAT' expediting procedures at any time you encounter delivery difficulties which threaten to cause failure to make delivery to us on the required date. The importance of this cannot be over-emphasized."[322]

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[316] Col Joe P. Walters, Chief, Bombardment Branch, Disposition Form: Request for Authority to Amend Letter Contract AF 33(038)-21096, 21 Mar 1952, in Box 3211: History of the B-52 Supplement, Box 11, ASC/HO Archive.
[317] Johnston to HQ ARDC, Subj: RB-52 Airplane Configuration, 14 Feb 1952, in Box 3211: History of the B-52 Supplement, Box 11, ASC/HO Archive.
[318] AMC, Directorate of Procurement and Production, Procurement Division, Aircraft Branch, Semiannual Report, B-52 Program, 1 Jan – 1 Jul 1952, pp. 4, 8, AFMC/HO Archive; Knaack, p. 222.
[319] Greene, p. 39; Brown, *Flying Blind,* p. 146; Knaack, pp. 553-557.
[320] Col K. L. Garrett, Chief, Aircraft Branch, Procurement Division, AMC, Disposition Form: Request for Authority to Amend Letter Contract AF 33(038)-21096, 13 May 1952, in Box 3211: History of the B-52 Supplement, Box 11, ASC/HO Archive.
[321] Col K. L. Garrett, Chief, Aircraft Branch, Procurement Division, AMC, Disposition Form: Amendment No. 13 to Letter Contract AF 33(038)-21096, 9 Jun 1952, in Box 3211: History of the B-52 Supplement, Box 11, ASC/HO Archive.
[322] F. E. Dobbins, Materiel Manager, Boeing, to All Boeing Vendors and Subcontractors, Subj: "BRICKBAT" PROGRAMS—Boeing Model B-52 Airplanes," 19 Jun 1952, in Box 3211: History of the B-52 Supplement, Box 11, ASC/HO Archive.

The production line for the B-52 at the Seattle facility. Only 297 of the big bombers were built in Seattle, while 467 were built at Boeing's facility in Wichita, Kansas. (*United States Air Force Museum, Orville Long Collection*)

Boeing reported a week later that deliveries of materials improved as a result of this directive.

August 4, 1952 AMC requested the authority to issue Boeing Letter Contract AF 33(600)-22119 for 43 additional RB-52B basic carrier convertible type airplanes with multi-purpose capsules installed and 43 bomber kits. The desired delivery schedule called for three airplanes per month between January and April 1955, stepping up to four per month in May. The delivery of the last of the 43 planes was scheduled for December 1955.[323] Supplement No. 12 raised this number to 68 B-52Bs at an estimated cost of $427 million (not including spares and engineering change funds).[324]

October 2, 1952 The XB-52 (49-230) made its first flight, lasting 2 hours 42 minutes. Like the YB-52, it was piloted by Tex Johnston, and Guy Townsend served as copilot.[325]

November 26, 1952 AMC turned support responsibility for the XB-52 and YB-52 under Contract AF 33-038 ac-15065 over to the Directorate of Supply and Services at the Oklahoma City Air Materiel Area, Tinker Air Force Base.[326]

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[323] Col K. L. Garrett, Chief, Aircraft Branch, Procurement Division, AMC, Disposition Form: Request for Authority to Issue Letter Contract AF 33(600)-22119, 4 Aug 1952, in Box 3211: History of B-52 Supplement, Box 11, ASC/HO Archive.
[324] B-52 Weapon System Survey, 6-18 Feb 1955, Office of the Inspector General, HQ AMC, Vol. 1 of 2, 9 Mar 1955, p. 21C, in Box 3205: B-52 Bomber Files, Box 5, ASC/HO Archive.
[325] Knaack, p. 223; "Second B-52 Test Flown," in *Army Navy Journal: Gazette of the Regular and Volunteer Forces*, including excerpts from Sep 20 to Nov 8, 1952, viewed online 5 Feb 2003, Armed Forces Journal International, at http://www.afji.com/AFJI/history/Mags/2002/july02/july_2.html.
[326] Frank L. Weidenmaier, Deputy, Requirements and Distribution, Directorate, Supply and Services, OCAMA, to CG, AMC, Subj: Contract AF21096 – B-52 Aircraft, 26 Nov 1952, in Box 3211: History of B-52 Supplement, Box 11, ASC/HO Archive.

The XB-52 finally took to the air in October 1952.

December 16, 1952 The Definitive Contract, superceding the letter contract dated February 14 and March 19, 1951, for the production of three B-52As and 17 RB-52Bs was approved.[327] After five years of development and a myriad of configurations, the turbojet-powered, swept-wing B-52 Stratofortress finally achieved a production contract, with the first production model (a B-52B) entering operational service with Strategic Air Command on June 29, 1955.

[327] Lt Col James P. Ferrey, Chief, Bombardment Section, AMC, Disposition Form: Definitization of Letter Contracts AF 33(038)-21096 and AF 33(038)-22706, 22 Oct 1952, in Box 3211: History of B-52 Supplement, Box 11; B-52 Weapon System Survey, 6-18 Feb 1955, 9 Mar 1955, p. 1A, in Box 3205: B-52 Bomber Files, Box 5, ASC/HO Archive.

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Following the flight test program, in 1957, the XB-52 flew to Wright-Patterson Air Force Base where it continued to be used for experimental tests. The YB-52 was donated to the United States Air Force Museum in 1958. Both aircraft were scrapped in the mid-1960s.[328]

The XB-52 came to Wright-Patterson Air Force Base on November 18, 1957, for testing alternate technologies. One such test included replacing four of the big bomber's eight J57 engines with two J75 engines. Shown here are Captain Jesse P. Jacobs and Major Harold W. Christian in January 1958, following a J75 test flight.

[328] Robert F. Dorr and Lindsay Peacock, *Boeing's Cold War Warrior: B-52 Stratofortress* (London: Osprey Aerospace, 1995), p. 233; Boyne, p. 62.

Operational B-52s

After years of difficult, controversial development, the B-52 program finally achieved a production contract in 1952. Thus began one of the most successful military aircraft production programs in the history of aviation. Production continued for 10 years, and over the next 40 years, the Air Force modified and upgraded the big bomber, keeping it relevant into the twenty-first century. In fact, on the 50th anniversary of the XB-52's first flight in 2002, the Air Force estimated that the latest models of the aircraft would remain in service for another 40 years or more.

The first production B-52A rolled out of the factory in March 1954. General Nathan F. Twining called it the "long rifle of the air age." It actually did not fly for the first time until August. Three B-52As were produced.

RB-52B. In March 1952, the Air Force contracted for 10 B-52Bs with bomber kits and reconnaissance capsules. In October 1951, Air Staff had directed that all B-52s be developed as reconnaissance versions.

Once the production decision had been made, the Air Force modified Boeing's contract several times. After first ordering 13 B-52As, the contract was changed to only three A models—used for service tests—and the remaining 10 on contract were changed to B models. Owing to Air Staff's decision in October 1951 that the Air Force did not have a need for the bomber version, the B models were procured as reconnaissance airplanes. By the end of 1952, 43 B-52Bs with provisions for removable reconnaissance pods were on contract. By mid-1953, the production contract had increased to 282 airplanes to equip seven Strategic Air Command (SAC) wings, and Boeing's Wichita, Kansas, facility was chosen as a second source to accelerate the production schedule. In 1955, the reconnaissance mission became secondary to the bombing mission.

Although only for service tests, the first production B-52A rolled out in March 1954, and made its first flight in August. The other two A models followed the same year. Unlike the XB and YB-52, the A (and all successive) models incorporated the side-by-side seating arrangement requested by General LeMay in March 1951. The B-52B made its first

In May 1956, a B-52B was used as part of Operation *Redwing*, the first time the United States dropped a thermonuclear bomb. The test took place at Enewetak Atoll in the Pacific Ocean. (*United States Air Force Museum Photo Collection*)

flight in December 1954. By June of the following year, SAC had its first operational B-52, assigned to the 93rd Bomb Wing at Castle Air Force Base, California. The B-52Bs were used primarily for crew training; however, on January 18, 1957, three B-52Bs set the record for the world's first non-stop round-the-world flight by a jet aircraft. The 24,325-mile trip took 45 hours 19 minutes with three aerial refuelings. In addition, on May 21, 1956, a B-52B conducted the first airdrop of a hydrogen bomb over the Bikini Atoll in the Pacific Ocean. Through this mission, the United States displayed its expanding global reach.

B-52C models followed the B model into operational service in 1956; D models late in 1956; E models in December 1957; Fs in mid-1958; Gs in early 1959; and H models in mid-1961. Delivery of the last B-52H in October 1962 raised the total number of B-52s procured by the Air Force, including experimental, test, and operational aircraft, to 744 vehicles.

It is particularly notable that even after a production decision was made, the Air Force and Boeing continued to develop or "grow" the aircraft, incorporating improved avionics, weapons, and structural changes in each successive model. Gross weight increased to 488,000 pounds (weight of the B-52B was 420,000 pounds), underwing drop tanks were added, the fire control system was steadily upgraded, and the engines became progressively more powerful. The G model, sometimes referred to as a "super B-52," carried a number of internal changes: integral fuel tanks in the wings, called "wet wings," which increased its range; a smaller vertical fin; an enlarged nose radome; a modified tail cone; and fixed external fuel tanks. At this time, the gunner was moved to a position in the forward fuselage with the rest of the crew. The H model sported TF33 turbofan engines, which increased its rate of climb, service ceiling, and range. On the production line, it was fitted with the best available electronic countermeasures equipment and fire control system, and its four .50-caliber guns were replaced with a single 20mm multi-barrel cannon.

Almost all models were retrofitted through various programs either to increase their service life or to make them more responsive to the Air Force's needs. Between 1959 and 1963, all B-52s (except the earliest B models) were given Big Four modifications that allowed them to penetrate enemy defenses at altitudes below 500 feet in all weather conditions. As part of Big Four, the aircraft were equipped to carry Hound Dog missiles and Quail decoys, improved bombing-navigation systems, Doppler radar, terrain avoidance radar, and low-altitude altimeters.[329]

The severe turbulence experienced during low-level flight led to structural fatigue, which was addressed through the Hi-Stress Program. Aircraft approaching 2,000 flying hours entered Phase I of the program—strengthening the fuselage bulkhead, aileron bay area, boost pump access panels, and wing foot splice plate. When the aircraft neared 2,500 hours, Phase II modifications were undertaken—reinforcing the upper and lower wing panels supporting the inboard and outboard engine pods, the upper wing surface fuel probe access doors, and the bottom portion of fuselage bulkhead. A third phase of the Hi-Stress Program was initiated in the mid-1960s. At this time, all early B-52 models were inspected for wing cracks, and their vertical fin spars and skin were replaced.[330]

The B-52H, which became operational in mid-1961, is expected to remain in service until 2040 or later. This model is powered by Pratt & Whitney's TF33 turbofan engines

The McDonnell ADM-20 Quail decoy program began in the mid-1950s. It was successfully flight tested in 1957 and became operational in 1961. The B-52 could carry up to eight ADM-20s in its bomb bay.

All B-52G/H wing structures were replaced in the mid-1960s also to prevent structural fatigue. During this program, Boeing replaced the old wing box beam with modified wing boxes of thicker aluminum, replaced titanium taper lock fasteners with stronger steel fasteners, added wing panel stiffeners, and applied a new protective coating to the interior structure of the integral wing fuel tanks.[331] These are only a few of the modifications conducted on the B-52 bombers that have kept them flying for the last 50 years.

Proponents of the bomber cite its flexibility as the main reason for its longevity. In 2002, Don Koranda, President of the National Aeronautic Association, commented:

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[329] Knaack, p. 253; Boyne. *Boeing B-52*, p. 154.
[330] Knaack, pp. 254-255, 255n.
[331] *Ibid*., pp. 276-277.

> "The remarkable thing…is its adaptability. This clearly is an airframe that has been very capable from the get go. They designed into it, by luck or whatever circumstances occurred, the ability to either accommodate the different bomb loads or the different mission capabilities."[332]

That capability was not a consequence of luck. Designers in the 1940s included room for growth in the airplane, even though it was built primarily as an atomic bomb carrier. The Air Force made the conscious decision to allow the B-52 to be an "alternate" bomb carrier when it accepted Model 464-17 in January 1947.

Through years of technology insertion, the B-52s have been able to flaunt their versatility. In 1963, General LeMay, Air Force Chief of Staff, asked Air Force Systems Command to study the conventional capability of the B-52. The Aeronautical Systems Division at Wright-Patterson Air Force Base oversaw four phases of the program, called Second Look. The program determined the B-52's bombing accuracy while carrying 750-pound and 1,000-pound biological, chemical, or general-purpose bombs, as well as M30 cluster bombs. Clip-in racks were added for easier loading.[333]

When the first B-52s deployed to Southeast Asia in June 1965, the event marked the first time the big bombers dropped any weapons in wartime and also the first use of the airplane for close air support, surely not a mission envisioned by its developers. In December 1965, the Air Force began Big Belly modifications on all B-52Ds destined for service in Southeast Asia. These changes allowed the aircraft to carry internally 84 (instead of 27) 500-pound bombs, or 42 (instead of 27) 750-pound bombs, in addition to the 24 500- or 750-pound bombs carried externally. These D models could also carry mines instead of gravity bombs and retained their capability to carry four nuclear gravity weapons also. The Big Belly models had a maximum bomb load of 60,000 pounds, or 22,000 pounds more than the B-52F. This program also provided special racks for loading bombs in the munitions area. These pre-loaded racks could be clipped quickly into the bomb bay.[334]

By 1972, the sortie rate for B-52s in Southeast Asia peaked at more than 3,000 per month. During the so-called "Eleven Day War" in the winter of 1972, the bombers flew more than 700 Linebacker II missions and dropped 15,000 tons of bombs on Hanoi and Haiphong in North Vietnam, leading to peace negotiations. By August 1973, when the United States stopped air missions over Southeast Asia, the B-52s assigned to the theater had flown more than 126,000 missions, with a loss of 31 aircraft. They dropped more than 2.6 million tons of bombs.[335]

As part of the Big Belly modifications for the B-52Ds being sent to Southeast Asia, Boeing developed a package system for loading the B-52. Conventional bombs could be pre-loaded into the rack and then towed to the bomber for faster loading. The B-52D could carry three of these packages internally. (*United States Air Force Museum Photo Collection*)

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[332] Don Koranda, Interview by CNN, viewed online 13 Jan 2003 at http://www.cnn.com/CNN/Programs/presents/shows/war.birds/archives/koranda.html.
[333] William W. Suit, "Utilitarian War Horse: Modifying the B-52 for Conventional War," *Air Power History* 44 (4) Winter 1997, pp. 40, 41.
[334] Knaack, p. 256; Boyne, *Boeing B-52*, p. 113.
[335] Walter J. Boyne, "Fifty Years of the B-52," *Air Force Magazine Online* 84 (12) Dec 2001, viewed online 13 Dec 2002 at http://www.afa.org/magazine/Dec2001/1201buff.html.

B-52D dropping its 60,000-pound load of iron bombs in Southeast Asia

In other evidence of their adaptability, during the early 1970s, the G and H models received modifications to allow them to carry the new AGM-69 Short Range Attack Missile (SRAM) on underwing pylons. The first SRAM-equipped B-52G was delivered to SAC in March 1972. It could carry 20 of the missiles, 12 externally (six on each pylon) and eight on a rotary launcher in the bomb bay.[336] Eighty D models also received Pacer Plank modifications, including new wings and skin that increased their efficiency by reducing drag. Pacer Plank added 7,000 hours of service life to each aircraft.[337]

To further upgrade the bomber's capabilities, during the 1980s, the Air Force installed the new digitized offensive avionics system (OAS), which included radar navigation and bombing systems, on the G/H models. The OAS gave the B-52 the capability to carry 20 of the new AGM-86 Air-Launched Cruise Missiles.[338] These modifications allowed the B-52s to reinforce their significance, despite their age, during Operation *Desert Storm*. In January 1991, seven B-52s flew from Barksdale Air Force Base, Louisiana, to the Persian Gulf to make the first strike of the war. This flight marked, at the time, the longest combat mission in history—covering more than 14,000 miles in 35 hours. The B-52Gs that participated carried AGM-86Cs, the conventional version of the Air-Launched Cruise Missile (CALCM). During the course of the war, B-52s flew more than 1,600 missions and dropped more than 25,000 tons of bombs, 40 percent of all weapons dropped by Coalition forces. The B-52 also proved itself a vital psychological weapon, as Iraqi troops deserted their units upon seeing, or hearing, the giant airplane approaching.[339]

A pylon load of AGM-86 Air Launched Cruise Missiles is attached to the wing of a B-52. The missile can only be carried on the B-52 bomber.

Through its various upgrades, the B-52 could carry a wider variety of weapons than the B-1B intended to replace it.[340] In 1993, the veteran bomber, hailed as "an unparalleled

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[336] Boyne, *Boeing B-52*, p. 154.
[337] Ron Thurlow, "Notable Events in BUFF History," 10 Oct 1994, Chronology on file at ASC/HO.
[338] Boyne, *Boeing B-52*, pp. 119-120.
[339] "The Gulf War: Air Force Performance in Operation Desert Storm," viewed online 16 Apr 2002 at http://www.pbs.org/wgbh/pages/frontline/gulf/appendix/whitepaper.html. Other sources cite that the B-52s released 30 percent of the total munitions tonnage. See "Operation Desert Storm: Limits on the Role and Performance of B-52 Bombers in Conventional Conflicts," General Accounting Office, Summary Report GAO/NSIAD-93-138, May 1993.
[340] Major Daniel E. Hobbs, *Adapting Strategic Aircraft Assets to a Changing World: Technology Insertion to Provide Flexibility*, Research Report No. AU-ARI-92-10 (Maxwell Air Force Base: Air University Press, 1994), p. 98.

A KC-10A Extender with the 380th Air Expeditionary Wing lowers its flying boom to provide fuel to an approaching B-52H Stratofortress during Operation *Enduring Freedom*. (*U.S. Air Force photo by Chaplain (Lt. Col.) Redmond Raux*)

Airman 1st Class Dino Dan, weapons loader, uses an MHU-83 lift truck to load a GBU-31 joint direct attack munition (JDAM) onto the wing of a B-52 Stratofortress during Operation *Iraqi Freedom*. (*U.S. Air Force photo by Staff Sgt. Kristina Barrett*)

stable platform for accurate bombing,"[341] could carry 34 different types of weapons, including general-purpose gravity bombs, cluster bombs, laser-guided bombs, sea mines, leaflet/chaff bombs, and air-launched cruise missiles. At the turn of the century, the B-52 remained the only Air Force aircraft able to employ a long-range cruise missile. Select aircraft were also modified to carry the Navy's Harpoon missile and the Israeli air-to-ground HAVE NAP missiles. The B-1B, for a conventional mission, could only carry the 500-pound gravity bomb.[342]

Fifty years after its first flight, the B-52 continued to soldier on in America's war on terrorism, Operation *Enduring Freedom*. It provided both close air support and precision bombing using the Joint Direct Attack Munitions (JDAM/GBU-31/32), which turned the Air Force's unguided bombs into all-weather guided weapons, and Wind Corrected Munition Dispenser (WCMD)-equipped CBU-86 cluster munitions, which the B-52 was able to drop in poor-weather conditions with an accuracy of 85 feet.[343]

The following year, during Operation *Iraqi Freedom* in early 2003, 28 B-52H bombers deployed to the Persian Gulf and maintained a 76 percent mission capable rate throughout the war. As in Operation *Desert Storm*, B-52s were part of the first air strike on Baghdad, on March 21, 2003. B-52s flew more than 120 close air support, airborne alert, strategic attack, interdiction, and leaflet-dropping missions, and they dropped 2,700 individual weapons. Milestones for the aircraft included the first wartime use of a laser-guided bomb with the aid of the Litening II targeting pod (developed initially for the F-15), and the first use

[341] *Ibid*., pp. 27, 98.
[342] United States General Accounting Office, Report to the Chairman, Committee on Armed Services, House of Representatives, *Strategic Bombers: Adding Conventional Capabilities Will Be Complex, Time-Consuming, and Costly,* GAO/NSIAD-93-45, Feb 1993, p. 3.
[343] Bruce Rolfsen, "Still Going Strong," *Air Force Times*, 10 Feb 2003, p. 14, viewed online 6 Feb 2003 at http://ebird.dtic.mil/Feb2003/s20030206152183.html; "New Systems Played Key Role in Afghanistan, Air Force Official Says," *Aerospace Daily*, 28 Feb 2002.

of a combat package that included all three of the Air Forces' bomber aircraft—the B-1B, B-2, and B-52.[344]

For all of its versatility, however, the B-52 has its weaknesses. It is much slower than the newer Air Force bombers and it has a large radar cross-section, both of which make it vulnerable to enemy fire. And one of the characteristics that makes it such an amazing airplane—its age—also makes it hard to maintain. In 1994, the Air Force retired the B-52Gs, leaving only 95 B-52Hs in the inventory.[345] Current plans, however, are to keep the B-52H in operation until 2045 or even longer. Individuals associated with the B-52's development and ongoing maintenance do not hesitate to say that it is not the same airplane flying today that flew over 50 years ago. In addition to the select few modifications mentioned above, each airplane gets a regular, intensive overhaul every four years, and contractors have submitted several proposals for re-engining the remaining aircraft with commercial high-bypass engines. Such an effort was estimated to reduce the Air Forces' fuel consumption nearly 35 percent and increase the B-52H's unrefueled range by 46 percent.[346] Near the end of 2003, the Air Force was considering another major divergence for the bomber: turning it into a standoff jamming platform, an EB-52 with joint electronic attack and bombing capability.[347]

Technical Sergeants Ken Williams and Noel Peters, clean the lenses on a Litening II pod mounted on a B-52 Stratofortress. On April 11, 2003, during Operation *Iraqi Freedom*, a B-52 used the targeting pod to strike an airfield in northern Iraq—the first time the pod had been used on a B-52 in a real-world situation. (*U.S. Air Force photo by Airman 1st Class Stacia M. Willis*)

A Good Starting Point

For nearly 40 years during the Cold War, the B-52 successfully fulfilled its role of nuclear deterrence, and it continues to be one of the most capable weapons in the United States arsenal. Despite popular accounts, this amazing aircraft was not designed overnight in a hotel room in Dayton. As illustrated by the previous chronology, many simultaneous programs lent data to the B-52 program. Possibly more important, Boeing cannot take all the credit for the B-52. The nation also owes a great debt of gratitude to a progressive, persuasive, "jet nut" by the name of Lieutenant Colonel Henry E. "Pete" Warden and his Bombardment Branch at Wright Field.[348] Boeing may have completed the actual design drawings and engineering, but Colonel Warden, along with his small staff in the Bombardment Branch, kept the B-52 alive for nearly five years in the face of intense criticism, repeated challenges to the aircraft's performance, and perhaps considerable damage to his own Air Force career. Warden's job was "to save the B-52, not once, but several times," which the preceding chronology shows he did successfully.[349]

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[344] U.S. Central Air Forces, Assessment and Analysis Division, "Operation Iraqi Freedom—By the Numbers," 30 Apr 2003 (Shaw AFB, South Carolina), pp. 7, 8, 10, 15; SMSgt Rick Burnham, "B-52 Still a Force to be Reckoned With," *Air Force Print News*, 14 Apr 2003, viewed online 14 Apr 2003 at http://www.af.mil/news; "B-52 Litening II Pod Used in Combat," *Air Force Print News*, 12 Apr 2003, viewed online 14 Apr 2003 at http://www.af.mil/news; SSgt Kristina Barrett, "Bomber Group Heads Home," *Air Force Print News*, 24 Apr 2003, viewed online 25 Apr 2003 at http://www.af.mil/news.

[345] Department of the Air Force, *Enhancing the Nation's Conventional Bomber Force: The Bomber Roadmap*, (1992), p. 8.

[346] Michael Sirak and Christopher Stagg, "Fresh Interest Brews to Re-Engine B-52s," *Jane's Defence Weekly*, 30 Apr 2003, viewed online 28 Apr 2003 at http://ebird.dtic.mil.

[347] Robert Wall, "Elevating Info War: USAF Electronic Attack Plans Remain Murky, but Industry Lines up to Bid," *Aviation Week and Space Technology*, 13 Oct 2003, viewed online 20 Oct 2003 at http://ebird.afis.osd.mil.

[348] In the interview with Hugh Ahman, Warden said, "I was a jet nut. The simplicity of that jet promised so much… that I would try to put jets on everything I could put them on."

[349] Warden, Interview with Lori Tagg.

Colonel Warden, the self-described "jet nut" who piloted the B-52 through its early development

Nearly 50 years later, Warden, reflecting on his refusal to give up on the bomber, stated, "I [didn't] want any part of building an average airplane."[350]

The question is often asked, "What keeps the B-52 flying and relevant?" The answer is the design, dating back to 1948, that produced a basic bomb truck capable of carrying high numbers and tonnage of bombs over long distances. In 2002, Major General Daniel P. Leaf, Director of Operational Requirements in the DCS/Air and Space Operations, commented:

"The innovative thinkers that designed the airplane to begin with forced us to jets when there was a temptation to field another propeller bomber. [They] built room for growth in it and had an aerodynamically sophisticated enough—although very big—airframe that allowed it to continue to fly. …The shift of the B-52's mission and of the threat environment and where and how we might fight is also very key to why the B-52 is still a viable weapon system. It was envisioned as a penetrating strategic nuclear bomber. That gave it a robust system for navigation, for communications and for weapons delivery for its time. So it had a good starting point. It also gave it a fairly undemanding flight profile early in its life and we haven't worn it out."[351]

General Leaf also called it "an icon for American strength, deterrence, and innovation, and our ability to do things that no other air force—no other nation—can, from a technological standpoint, from a conceptual and a human standpoint."[352] The weapons development and modernization programs that have brought the B-52 to this point will be explored in a separate volume.

The B-52 symbolized American strength and reach during the Cold War. In August 2003, a B-52 was put on display in Russia for the first time at the Moscow Aviation and Space Show at Zhukovsky Airfield. (*U.S. Air Force photo by Master Sgt. Kenneth Fidler*)

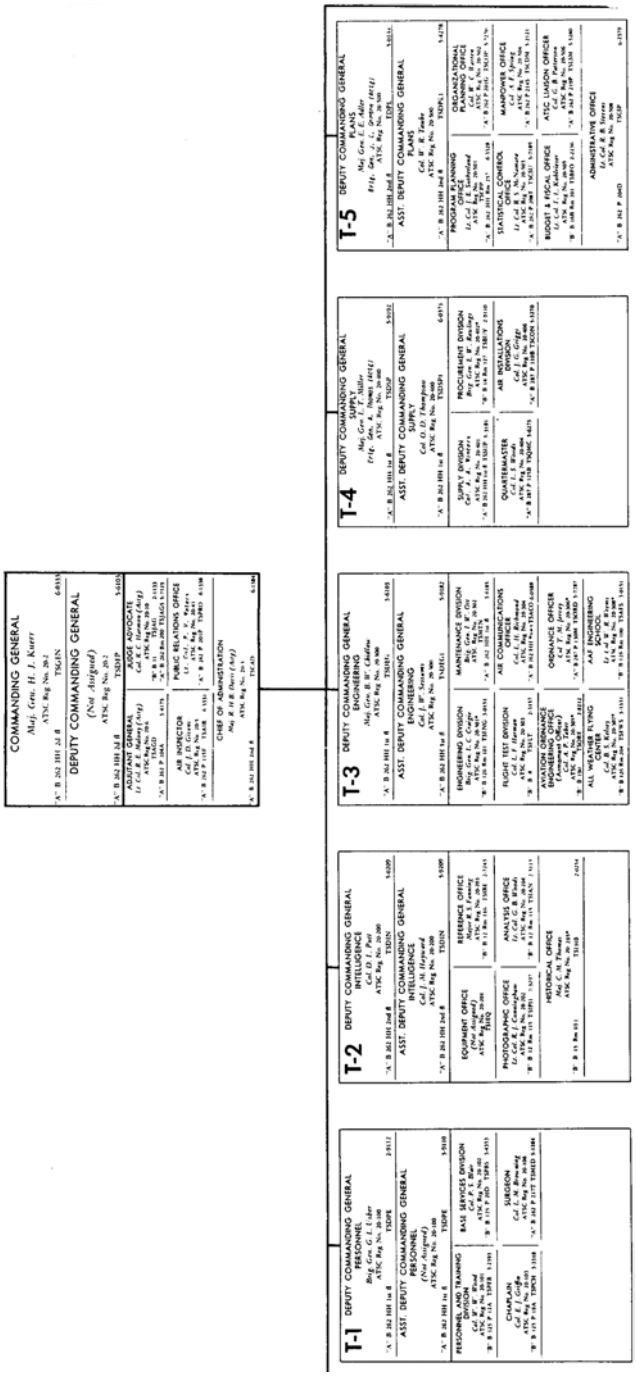
[350] Warden, Interview with Hugh Ahman.
[351] General Daniel P. Leaf, Interview by CNN, viewed online 13 Jan 2003 at http://www.cnn.com/CNN/Programs/presents/shows/war.birds/archives/leaf.html.
[352] *Ibid*.

GLOSSARY

AAF	Army Air Forces
AC/AS-3	Assistant Chief of Air Staff for Operations and Training
AC/AS-4	Assistant Chief of Air Staff for Materiel, Maintenance, and Distribution
AFMC	Air Force Materiel Command
AMC	Air Materiel Command
ARDC	Air Research and Development Command
ASC	Aeronautical Systems Center
ASC/HO	Aeronautical Systems Center History Office
ATO	Assisted Takeoff
ATSC	Air Technical Service Command
AWS	Air Weather Service
BG	Brigadier General
Capt	Captain
CG	Commanding General
Col	Colonel
CPFF	Cost Plus Fixed Fee
DCS	Deputy Chief of Staff
GEM	Global Electronics Modification
Gen	General
GFP	Government Furnished Product
HQ	Headquarters
IFF	Identification Friend or Foe
JPO	Joint Program Office
LG	Lieutenant General
Lt Col	Lieutenant Colonel
Maj	Major
MG	Major General
MIT	Massachusetts Institute of Technology
n.d.	No date
n.mi.	Nautical Miles
NACA	National Advisory Committee for Aeronautics
OCAMA	Oklahoma City Air Materiel Area
R&D	Research and Development
RAND	Research ANd Development
RB	Reconnaissance version of a bomber aircraft
RDC	Research and Development Command
RFP	Request For Proposals
SAC	Strategic Air Command
SFC	Specific Fuel Consumption
subj.	Subject
Sup. Doc.	Supporting Document
USAF	United States Air Force
VHB	Very Heavy Bomber
WADC	Wright Air Development Center
WADD	Wright Air Development Division
WPAFB	Wright-Patterson Air Force Base
WSPO	Weapons System Project Office
XB	Experimental Bomber
YB	Service Test or Prototype Bomber

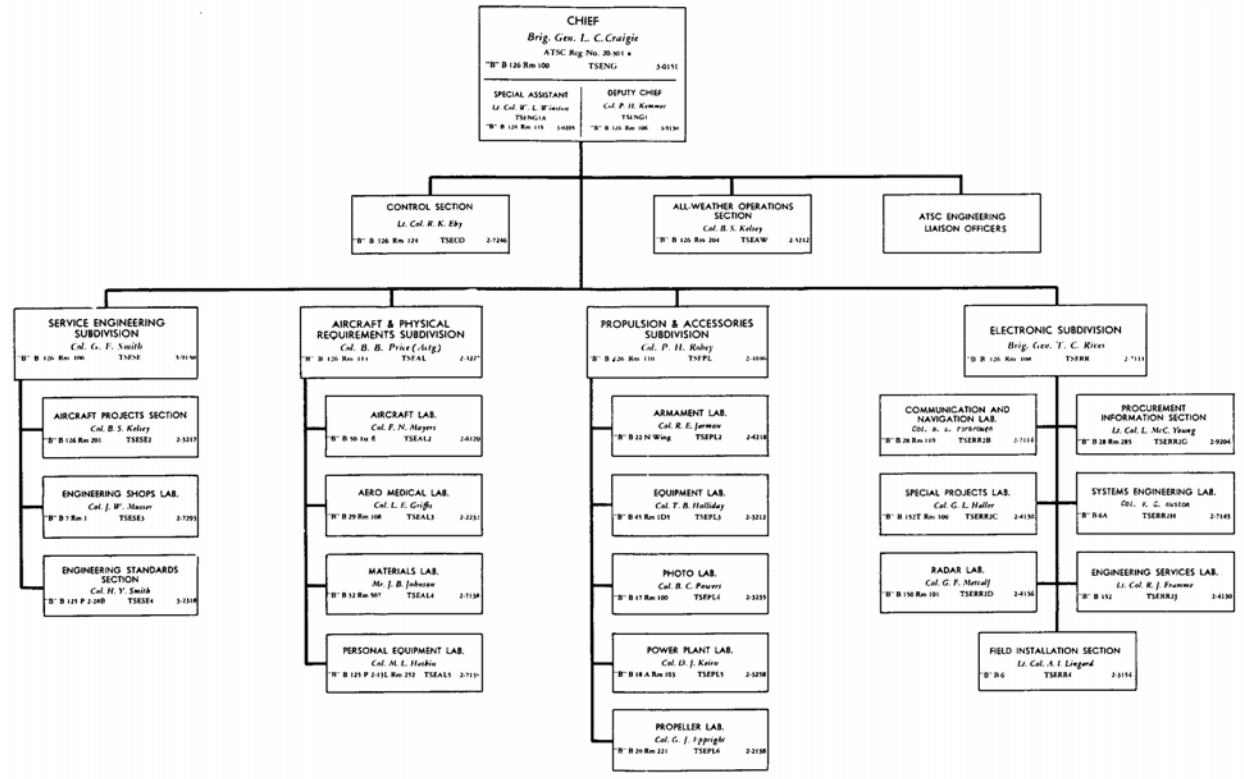
Appendix 1

Chart 1



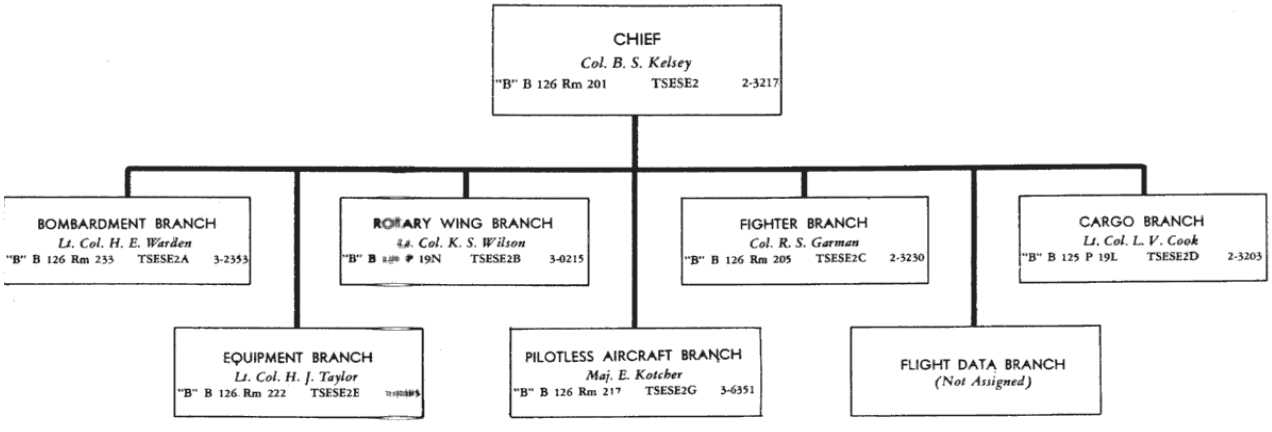
Air Technical Service Command, organizational chart for October, 17, 1945

Chart 2



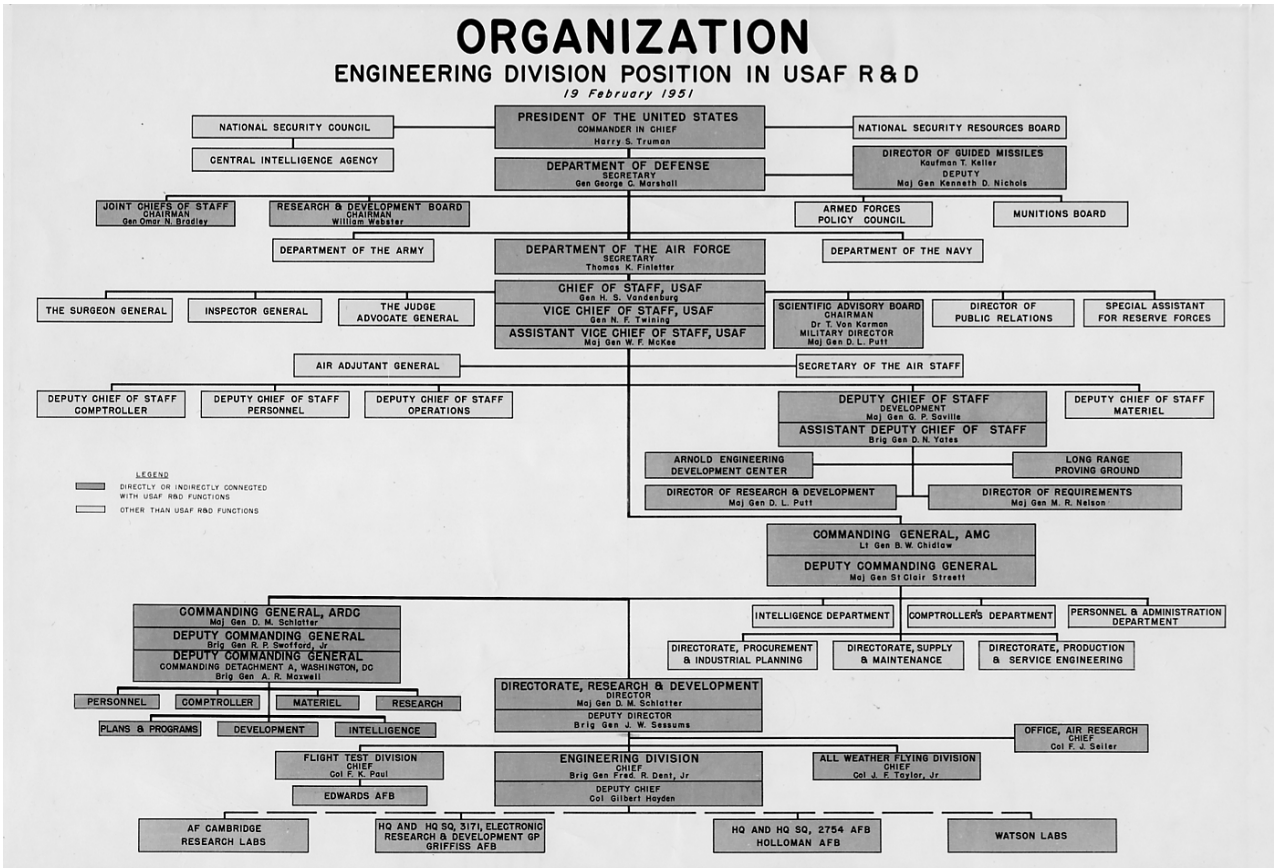
Engineering Division, T-3 Engineering, Air Technical Service Command, organizational chart for October 1, 1945

Chart 3



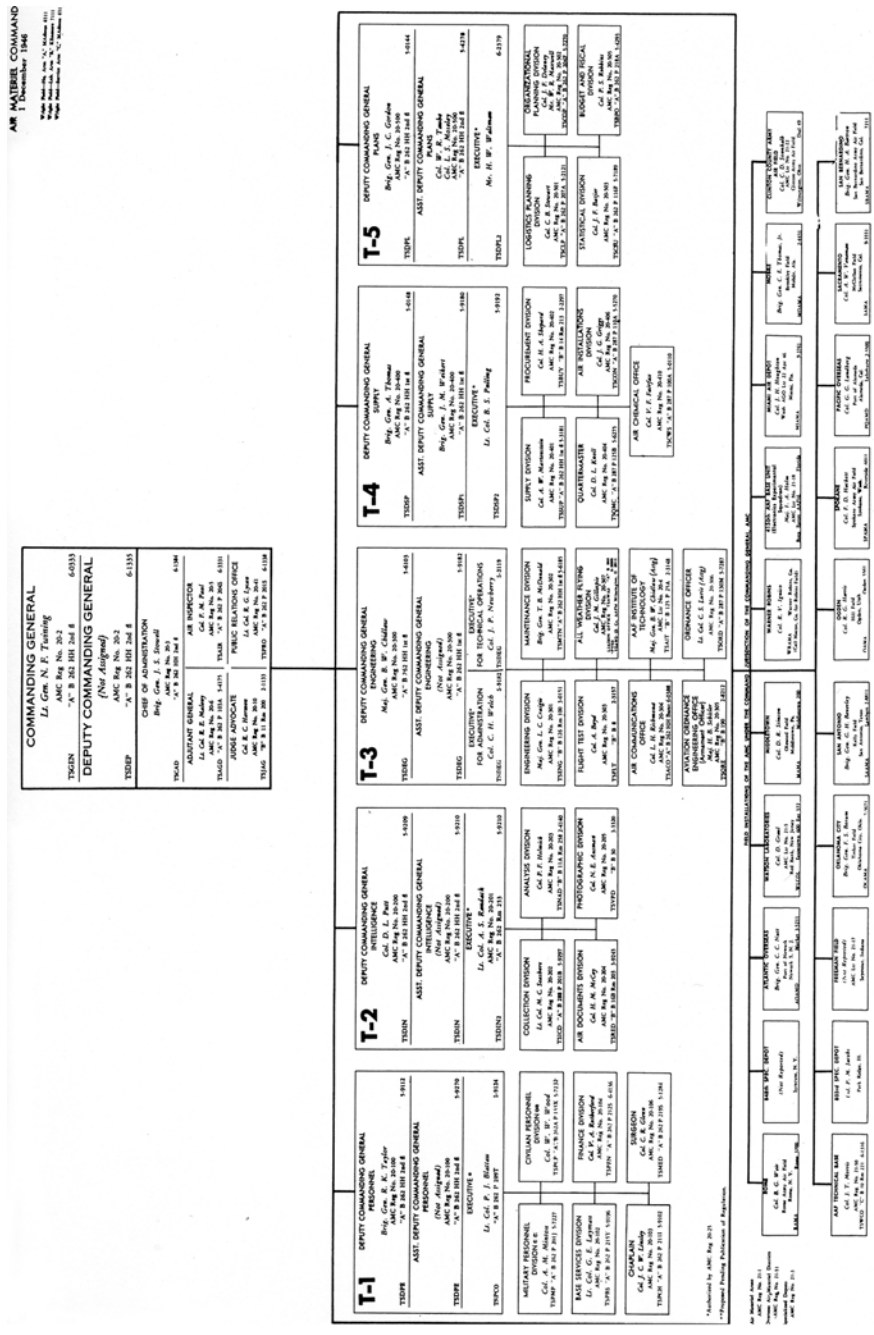
Aircraft Projects Section organizational chart for October 1, 1945

Chart 4



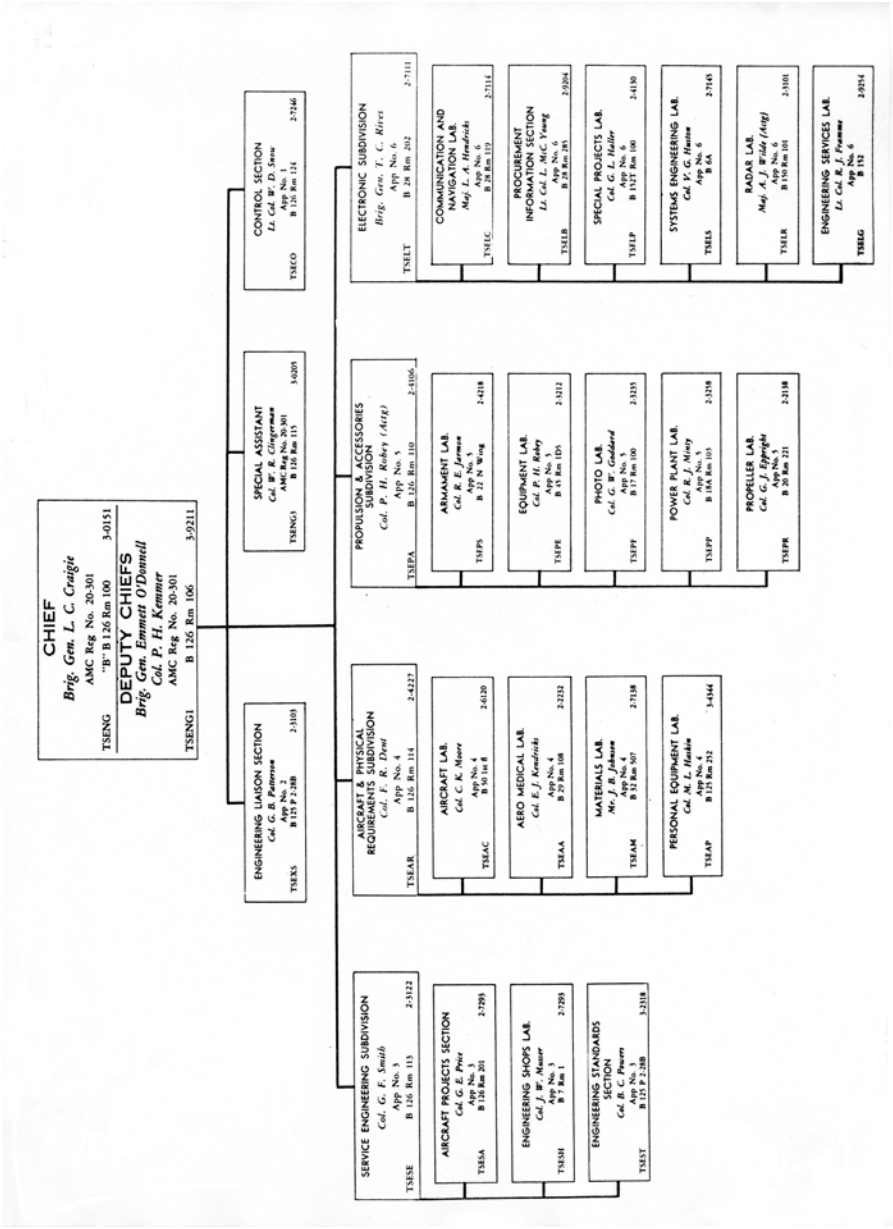
Organizational chart showing the position of the Engineering Division at Wright-Patterson Air Force Base in the overall scheme of Air Force research and development, February 19, 1951. This chart would have looked different if compiled in the late 1940s, but it illustrates the path of interaction and interplay involved in the development of new equipment.

Chart 5



Air Material Command, organizational chart for December 1, 1946

Chart 6



Engineering Division, T-3 Engineering, Air Materiel Command, organizational chart for July 1, 1946

SUMMARY & COMPARISON -- PERFORMANCE DATA

HEAVY BOMBARDMENT

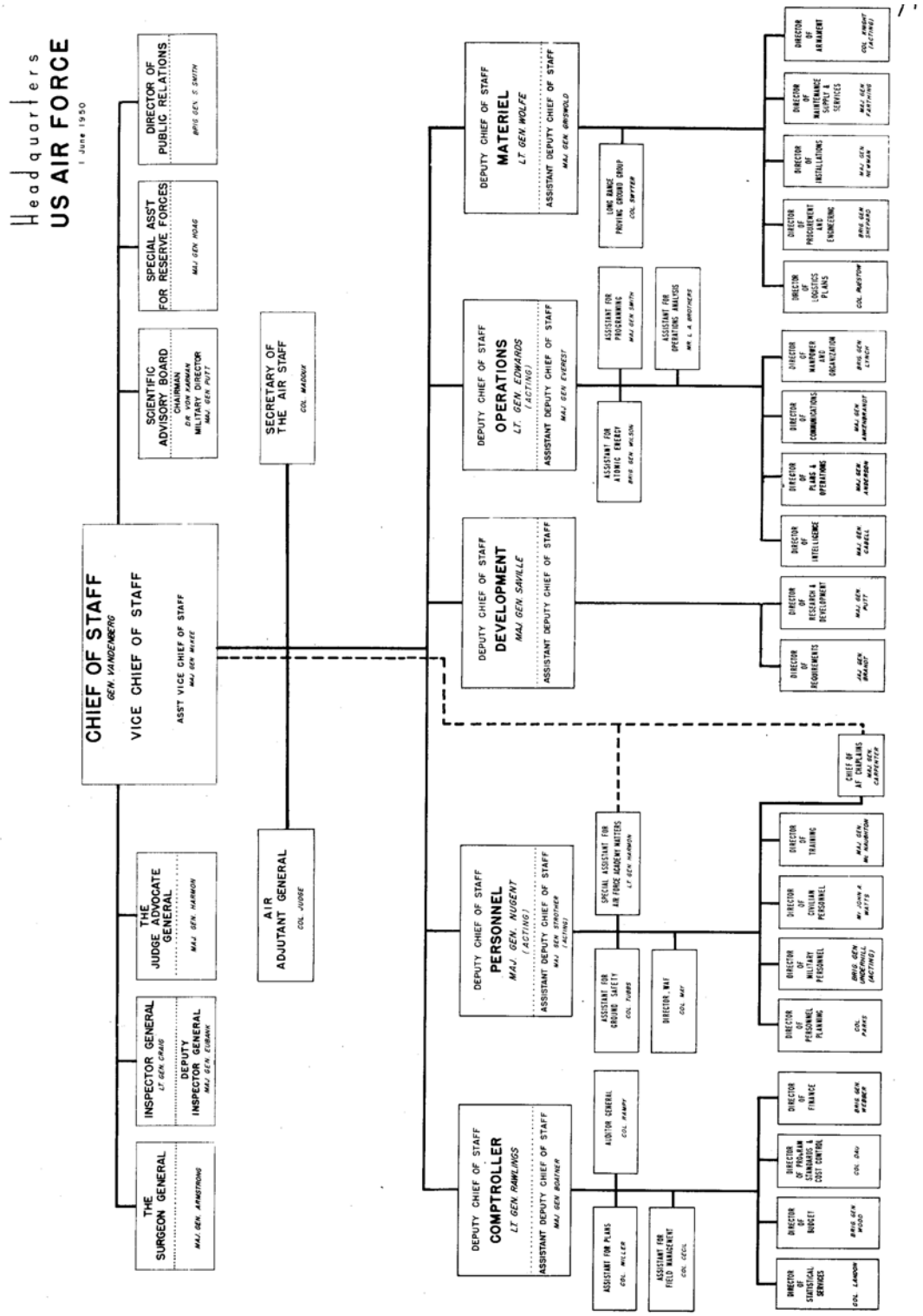
Item	Military Characteristic, Dated 25 Nov 45	Boeing Model 462	CVAC	Martin Model 236	B-50	YB-36
Design Gross Weight	----------	360,000	235,000	275,000	120,000	278,000
Design Gross Weight, less 1/2 Fuel	----------	275,000	185,900	221,145	100,320	207,268
Maximum Alternate Gross Weight	----------	400,000	290,000	275,000	140,000	320,000
Weight Empty	----------	168,000	116,443	142,120	75,000	129,778
Ratio - Useful Load/Weight Empty	----------	1.14	1.09	0.93	0.6	1.14
ng Area	----------	3,250	4,000	3,930	1,738	4,772
lect Ratio	----------	15	7.0	8.5 gec. 11 effect.	11.53	11.08
ing Loading, D. G. W.	----------	110.8	58.8	70.0	59	58.3
ing Loading, Max. Alter., G.W.	----------	123.0	72.5	70.0	81	67
Span	----------	221	167	195	141	230
Vmax, sea level	----------	388	448	389	293	277
Vmax, Tactical Oper. Alt. (15 Min)	450	450	520	475	370	339
Tactical operating altitude	35,000	35,000	35,000	35,000	35,000	30,000
Service ceiling	40,000	39,300	44,300	41,700	35,400	34,600
Service ceiling - 1/2 Engines	15,000	19,400	27,500	25,000	3,000	22,000
Rate of Climb, sea level	----------	2,350	3,950	3,390	1,300	760
Rate of Climb, Tact.Oper. Altitude	----------	420	1,[illegible]	920	75	245
Time to Climb, to Tact. Oper. Altitude	----------	cannot @ 360,000	15.6	17.2	53	61.0
Tactical Oper.Radius, D.G.W. 10,000# bombs	----------	3,110	2,445	2,147	1,106	3,530
Weight Fuel Above Radius	----------	169,800	98,200	107,709	-------	121,464
Tactical Oper.Radius, D.G.W.,44,000# bombs	----------	2,440	1,538	?	-------2,190 @ 265M	
Weight Fuel Above Radius	----------	132,000	64,200	-------	-------	73,500
Tactical Oper.Radius Max Alt G.W.10,000# bombs	5,000	3,570	3,189	2,147	1,500	-------
Weight Fuel Above Radius	----------	210,000	147,700	107,709 (with 15,000# bombs)	-------	-------
Tactical Oper.Radius,Max Alt G.W.44,000# Bombs	--------	2,960	2,382	?		-------
Weight Fuel Above Radius	----------	176,400	113,700	-------		-------
Average Speed, Mission at Design G.W.	300	410	364	407	293	240
Take-off Dist. 50' Obst. Design Gross Wt.	7,500	5,500	2,450	4,370	2,790	6,000
Take-off Distance, 50' Obst. Max.Alter.G.W.	7,500	7,200	4,070	4,370	4,000	10,600
Coeff of Rolling Frict. Used	----------		0.04	0.05	?	0.04
Landing distance 50' Obst.DGW less Bombs & drop fuel	4,500	3,760	3,550	3,600	?	3,640
Same - using Reverse pitch Props.	----------	-------	2,600	--------	?	?
Landing Speed	----------	114	114	?	?	112
Fuel Weight Used @1 Cal.	----------	6	6.7	6.17	6.0	6.0
Wing Thickness C/C	----------	15	18	12	-------	22 - 17
Cd	----------	0.0[illegible]	0.0142	0.0[illegible]	-------	?

NOTE: All Airplane data above are from Model Spec. & Aerodynamic Reports. Corrections have not been applied by Aircraft Lab. Some values, especially Vmax, range, and take-off will suffer considerable reduction.

Chart 7

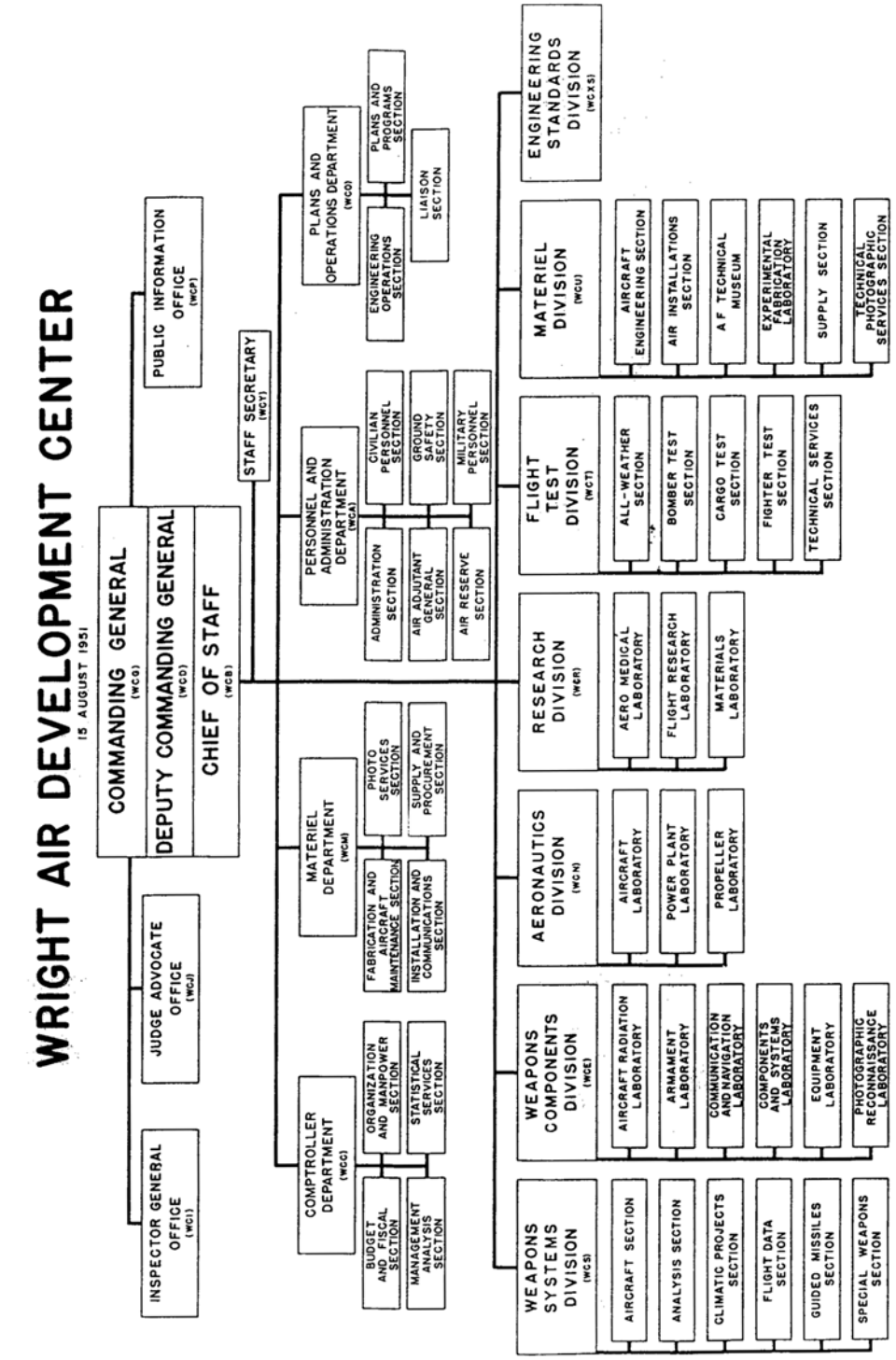
This chart shows the summary and comparison of the three designs submitted in response to military characteristics for a long-range heavy bomber issued in November 1945.

Chart 8



Headquarters Air Force, organizational chart for June 1, 1950. The majority of Air Staff involved with the B-52 program were within the offices of the Deputy Chief of Staff for Development and for Materiel.

Chart 9



Wright Air Development Center, organizational chart for August 15, 1951

Appendix 2

13 Aden
8-(13pp)
Bomb Br, Eng Div

40

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HEADQUARTERS, ARMY AIR FORCES

WASHINGTON, D.C.

~~SECRET~~

23 November 1945
(Revised 8 October 1946)
(Para. 1 c(2) revised)

SUBJECT: Military Characteristics for Heavy Bombardment Aircraft

TO: Assistant Chief of Air Staff - 4

1. The following principal characteristics for military airplanes have been approved.

a. Type - Heavy Bombardment

b. Class - High speed, high altitude, long range, land airplane.

c. Mission - The destruction by bombs of surface objectives.

d. Requirements

	Performance (At design gross weight condition less one-half fuel unless otherwise specified)	Minimum Requirements
(a)	High speed at tactical operating altitude for 15 minutes	450
(b)	Tactical operating altitude	35,000
(c)	Service ceiling	~~40,000~~
(d)	Service ceiling - 1/2 engine	15,000
(e)	Tactical operating radius with 10,000 lb. bomb	5,000
(f)	Average speed for above radius	300
(g)	Take-off over 50' obstacle at design gross weight	7,500
(h)	Landing over 50' obstacle at design gross weight condition less droppable fuel and bombs	4,500

Classification Cancelled or Changed to
~~Top Secret~~ Secret
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Changed NOV 1948
AUTHORITY, C. G., AIR MATERIEL COMMAND
REPORT CD-356 APRIL 8 1948
By: ALDEN R. CRAWFORD, Brig. Gen., U.S.A.

(2) If after the above requirements have been met, additional performance may be realized, consideration in the design of this aircraft for utilizing this performance should be given to those features such as high speed,

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13 Dec. 8-(7/3 pp)

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REPORT CD-356 1 APR 48
By: ALDEN R. CRAWFORD, Brig. Gen., U.S.A.

Military Characteristics of Aircraft - HEAVY BOMBARDMENT
23 November 1945 (Revised 8 October 1946)

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armament and passive protection which will reduce its vulnerability in penetrating heavily defended zones.

e. Armament

(1) Bombs - The maximum bomb load shall consist of one 80,000 lb. (Grand Slam configuration) bomb carried internally. Maximum design bomb loads shall be made up primarily around 500 lb. G.P. bombs with a minimum of 120 required and alternate loads shall be made up as efficiently as possible of 100 lb., 2000 lb., 4000 lb., 12,000 lb., 22,000 lb., or 44,000 lb. bombs. Leakproof bomb bay range extension tanks shall be provided to give maximum possible interchangeability between fuel and bomb load. Provisions for air-to-ground guided missiles and for the control thereof shall be required as offensive armament.

(2) Guns - Accurate fire control devices will be provided for offensive and defensive armament. Defensive armament shall consist of 20mm cannons mounted in no-drag power mounts. These weapons shall be located for all-round firing with a minimum number of blind spots. Weapons may be controlled remotely if necessary or feasible to achieve aerodynamic cleanness. Computing sights shall be provided at all sighting stations.

(3) Armor - Armor protection (flak curtains or deflector plate) shall be provided for engines, vital airplane components, crew and internal fuel against fighter, ground fire, and guided missiles. The maximum protection consistent with airplane weight and performance requirements is necessary.

f. Crew

(1) The minimum crew shall consist of pilot, co-pilot, flight engineer, one bombardier-navigator, one radio operator, and the minimum number of fire control operators deemed necessary. The arrangements of the crew shall provide for efficient performance of missions over the maximum radius of operation and shall permit the interchange of station by crew members. Accommodations will be provided for relief crews, consisting of one command pilot, one relief pilot, flight engineer, two bombardier-navigators, and one radio operator.

g. Equipment

(1) Radio and radar equipment for bombing, navigation, fire control, and countermeasure purposes shall receive prime consideration and shall be in accordance with current Military Requirement policy governing same.

(2) Instruments and navigational equipment shall be the minimum consistent with the requirements for effective day and night operations of the airplane on military missions in all weather conditions.

(3) The airplane shall be pressurized in accordance with current Military Requirements policy. Adequate window defrosting and air conditioning shall be provided to permit maximum crew efficiency at all altitudes and weather

13 Nov.
8-(3/3 pp)

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Military Characteristics of Aircraft - HEAVY BOMBARDMENT
23 November 1945 (Revised 8 October 1946)

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conditions.

(4) Adequate equipment shall be provided for anti-icing to allow all weather operation.

h. Structure and Design Features

(1) These features of design that will permit accurate bomb dropping, accurate navigation, the most effective defensive firepower, and maneuverability for formation flying, will be of primary consideration in the design of this airplane.

(2) Reliability and ease of maintenance under field conditions should be emphasized. Quick change features for engines and the main structural components are essential. Simplicity and ease of refueling, rebombing, and arming should be stressed to insure extreme field flexibility. Consideration should be given in basic design to features providing maximum independence of operation for maintenance and servicing with a minimum of specialized ground equipment.

(3) Emphasis must be placed on reduction of fire hazards through engineering design. Fire extinguishers must be easily operated in flight to control engine fires. A maximum reduction of fire probability through battle damage must be obtained by careful engineering.

(4) Emphasis must be placed on features to expedite rebombing and re-arming time so that such time shall not exceed preflight and refueling time.

(5) Consideration will be given to the use of increased engine ratings or assisted take-off devices for reducing the take-off distance below those specified in paragraph d(1) (h).

(6) Simplicity of design and suitability to quantity production should be emphasized.

FOR THE COMMANDING GENERAL:

/s/ Alfred R. Maxwell
ALFRED R. MAXWELL
Brig. General, U.S.A.
Chief, Requirements Division
Office of Asst Chief of Air Staff-3

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(SEE NEXT PAGE FOR DISTRIBUTION) -3-

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Appendix 3

13 Nov.
12-(13-48)
Bomb. Br, Eng. Div.

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General

HEADQUARTERS, ARMY AIR FORCES
WASHINGTON 25, D.C.

23 June 1947

Classification Cancelled or Changed to ~~Top Secret~~ ~~Confidential~~ Secret ~~Restricted~~

SUBJECT: Military Characteristics of Aircraft

CHANGED NOV 1948

TO: Assistant Chief of Air Staff - 4

AUTHORITY, C. G., AIR MATERIEL COMMAND
REPORT CD-356 1 APR 1948
By: ALDEN R. CRAWFORD, Brig. Gen., U.S.A.

1. The following principal characteristics for military aircraft are approved:

a. Type - Heavy Bombardment.

b. Class - High Speed, High Altitude, Long Range, Land Airplane.

c. Mission - The destruction by Atomic Bombs of surface objectives.

d. Requirements -

(1) Performance	Minimum Acceptable
(At design gross weight condition less one-half fuel unless otherwise specified)	
(a) High speed at tactical operating altitude for 15 minutes.	420 mph
(b) Tactical operating altitude.	35,000 ft.
(c) Service ceiling.	40,000 ft.
(d) Service ceiling - 1/2 engine.	15,000 ft.
(e) Tactical operating radius with 10,000 lb. bomb load with full fuel load.	5,000 statute miles
(f) Average speed for above radius.	~~420~~ 400 mph
(g) Take-off over 50' obstacle at design gross weight (without assisted take-off devices).	~~7,500 ft.~~
(h) Landing over 50' obstacle at design gross weight condition less droppable fuel and bombs.	7,500 ft.

(2) If after the above requirements have been met, additional performance may be realized, consideration in the design of this aircraft for utilizing this performance should be given to (1) high speed, (2) armament and (3) passive protection which will reduce its vulnerability in penetrating heavily defended zones.

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e. Armament -

*(1) Bombs - The airplane will be designed primarily to carry an Atomic Bomb internally. Provisions for standard bombs from the 500 lb. type up to the 22,000 pound type bomb and aerial mines are desirable; provisions for the 44,000 pound type will be desirable if the bomb is standardized at a later date. If practical, provisions should be made for ready inclusion, at a later date, of an internally stowed fighter and an air-to-surface guided missile with 100 to 300 mile range.

(2) Fire Control System - In accordance with current Military Characteristics, dated 27 May 1947, subject: "Heavy Bomber Fire Control System". Provisions for razon type of guided bomb are definitely required. Consideration should be given to design which will facilitate modification, within the useful life of this airplane, to substitute air-to-air guided missiles now under development.

(3) Armor - Armor protection (flak curtains or deflector plate) shall be provided for engines, vital airplane components against fighter, AAA fire, and guided missiles. The maximum protection consistent with airplane weight and performance requirements is necessary. Crew members will be equipped with flak suits.

f. Crew

*(1) The desired crew shall consist of pilot, co-pilot, two technicians, flight engineer, two bombardier-navigators, one RCM operator, one radio operator-gunner, and the minimum number of turret operators deemed necessary. The arrangements of the crew shall provide for efficient performance of missions over the maximum radius of operation and shall permit the interchange of station by crew members.

g. Equipment -

(1) Bombing and Electronic Equipment - In accordance with Material Requirement Directive 16-1 and Addendum I thereto, dated 16 May 1947, The best visual and radar bomb sights are required.

(2) Instruments and equipment shall be adequate for effective day and night operations of the airplane on military missions in all weather conditions.

h. Structure and Design Features -

(1) These features of design that will permit accurate bomb dropping, accurate navigation, the most effective defensive firepower, and maneuverability, will be of primary consideration in the design of this airplane.

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12-(3/3 pp)

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Subj: Proposed Military Characteristics for Heavy Bombardment Aircraft

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* (2) Reliability and ease of maintenance under field conditions should be emphasized. Quick change features for engines and the main structural components are essential. Simplicity and ease of refueling, rebombing, and rearming should be stressed to insure extreme field flexibility.

* (3) Emphasis must be placed on features to expedite rebombing and rearming time so that such time shall not exceed preflight and refueling time.

(4) Consideration will be given to the use of increased engine ratings or assisted take-off devices for reducting the take-off distance below those specified in paragraph 1d (1) (g).

(5) Simplicity of design and suitability to quantity production should be emphasized.

2. The foregoing principal characteristics for military aircraft supersede "Military Characteristics for Heavy Bombardment Aircraft", dated 23 November 1945.

FOR THE COMMANDING GENERAL:

ALFRED R. MAXWELL
Brigadier General, USA
Chief, Requirements Division
Office of Asst. Chief of Air Staff - 3

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Appendix 4

XB-52
Hist. Office, WPAFB
(1/2 pp)

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~~S E C R E T~~

8 December 1947

SUBJECT: Military Characteristics for Heavy Bombardment Aircraft

TO: Deputy Chief of Staff, Materiel

1. The following principal characteristics for Heavy Bombardment Aircraft are approved:

a. Class - High speed, high altitude, land airplane.

b. Mission - The destruction of surface military targets by atomic bombs.

c. Requirements -

(1) Performance (At design gross weight condition less one-half fuel unless otherwise specified)

		Minimum Requirements
(a) High speed	Tactical Operating Altitudes	435+ knots
(b) Tactical Operating Altitude		35,000 ft.
(c) Service ciling 1/2 engines		15,000 ft.
(d) Range at design gross weight condition		6956 N. Miles
(e) Average speed for above range		435 knots
(f) Take-off over 50' obstacle at design gross weight condition (with assisted take-off devices)		9,000 ft.
(g) Landing over 50' obstacle at design gross weight condition less droppable fuel and bombs.		9,000 ft.
(h) Average bomb load		10,000 lbs.

(2) If, after the above requirements have been met, additional performance may be realized, consideration in the design of this aircraft for utilizing this performance should be given to increased cruising speed.

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d. Armament

(1) Guns - Tail only (radar controlled). (220° arc of fire)

(2) No armor protection.

e. Crew

(1) the crew (of five) shall consist of a pilot, relief pilot (engineer & radio operator), bombardier-navigator, weaponeer (bombardier-navigator), and one (1) gunner.

f. Equipment

(1) Instruments and navigation equipment shall be the minimum consistent with the requirements for effective day and night operation of the airplane on military missions under all-weather conditions. The best radar-visual bomb sight is required.

(2) No RCM is required.

g. Structure and Design Features.

(1) Simplicity of design and suitability to production should be emphasized.

(2) All-around purging and self-sealing for fuel.

(3) Provisions for refueling in the air.

2. The foregoing principal characteristics for military aircraft supersede "Military Characteristics for Heavy Bombardment Aircraft", dated 23 June 1947, under which the present B-52 aircraft is being studied.

FOR THE CHIEF OF STAFF:

/s/ F. H. Smith, Jr.

F. H. SMITH, JR.
Brigadier General, USAF
Secretary, USAF Aircraft & Weapons Board

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Appendix 5

B-52
452.1 VHB
Vol. 2, 1948
CE-Wash.
(1/3 pp)

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AFORQ/B
LtColThorup/cem/71608
Wrtn: 1 March 48

3 MAR 1948

SUBJECT: Military Characteristics for Heavy Bombardment Aircraft

TO: Deputy Chief of Staff, Materiel

1. The following principal characteristics for Heavy Bombardment Aircraft are approved:

a. Class - High speed, high altitude, land airplane.

b. Mission - The destruction of surface military targets by atomic bombs.

c. Requirements -

(1) Performance

(a) High Speed at Tactical Operating Altitude (at design gross weight condition less one-half fuel)	478+ knots desired 435+ knots required
(b) Tactical Operating Altitude (at design gross weight condition less one-half fuel)	45,000 feet desired 40,000 feet required
(c) Service Ceiling 1/2 Engines (at design gross weight condition less one-half fuel)	20,000 feet
(d) Range at Design Gross Weight Condition (4,000 N.M. Radius)	9,500 N.M.
(e) High Cruising Speed (high cruising speed must be maintained over the 4,000 N. Miles subsequent to the first 2,000 N. Miles of flight. Lower cruising speeds are acceptable for balance of flight)	478 knots desired 435 knots required
(f) Take-Off over 50-foot Obstacle at design gross weight condition (without assisted take-off devices)	6,500 feet desired 9,000 feet required

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B-52
452.1 VHB
Vol. 2, 1948
CF-Wash.
(2/3 pp)

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Subj: Military Characteristics for Heavy Bombardment Aircraft

(g)	Landing over 50-foot Obstacle at design gross weight condition	6,500 feet desired 9,000 feet required
(h)	Average Bomb Load	15,000 lbs.

(2) If, after the above requirements have been met, additional performance may be realized, consideration in the design of this aircraft for utilizing this performance should be given to increased cruising speed.

d. Armament

(1) Guns - tail only (radar controlled) (arc of fire from wing tip to wing tip)

(2) No armor protection required except for engines.

e. Crew

(1) The crew (of six) shall consist of a pilot, relief pilot (radio operator), bombardier-navigator, weaponeer (bombardier-navigator), engineer, and one (1) gunner (radio operator).

f. Equipment

(1) Instruments and navigation equipment shall be the minimum consistent with the requirements for effective day and night operations of the airplane on military missions under all weather conditions. The best radar-visual bombsight is required. RCM equipment is required.

g. Structure and Design Features

(1) Simplicity of design and suitability to production should be emphasized.

(2) All-around purging required. Self-sealing required for all fuel except that which is used in the first 2,000 miles of flight.

(3) This aircraft design must incorporate wheel loadings suitable for continuous operation from Limestone Air Force Base.

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Subj: Military Characteristics for Heavy Bombardment Aircraft

h. Reconnaissance Provisions

(1) The design of the aircraft should permit production line changes to be made which will provide the Special Equipment Installations and Tactical Capabilities envisaged by current military characteristics for Strategic Reconnaissance aircraft. In conversion for reconnaissance utilization emphasis will be placed upon increasing the speed and altitude performance of the aircraft.

FOR THE CHIEF OF STAFF:

Leslie O Peterson
Colonel, USAF

LESLIE O. PETERSON
Colonel, USAF
Chief, Requirements Division
Directorate of Training & Requirements

BIBLIOGRAPHY

Published Sources

"B-52 Litening II Pod Used in Combat." *Air Force Print News*, 12 April 2003. Viewed online 14 April 2003 at http://www.af.mil/news

Barrett, SSgt Kristina. "Bomber Group Heads Home." *Air Force Print News*, 24 April 2003. Viewed online 25 April 2003 at http://www.af.mil/news.

Boyne, Walter J. "Fifty Years of the B-52." *Air Force Magazine Online* 84 (12) December 2001. Viewed online 13 December 2002 at http://www.afa.org/magazine/ Dec2001/1201buff.html.

_____. *Boeing B-52: A Documentary History*. London: Jane's Publishing Company Limited, 1981.

Bridgeman, Leonard, ed. *Jane's All the World's Aircraft, 1949-1950*. New York: McGraw-Hill Book Co., Inc., 1949.

Brown, Michael E. *Flying Blind: The Politics of the U.S. Strategic Bomber Program*. Ithaca: Cornell University Press, 1992.

Burnham, SMSgt Rick. "B-52 Still a Force to be Reckoned With." *Air Force Print News*, 14 April 2003. Viewed online 14 April 2003 at http://www.af.mil/news

Collins, Martin J. *Cold War Laboratory: RAND, the Air Force, and the American State, 1945-1950*. Washington, D.C.: Smithsonian Institution Press, 2002.

Department of the Air Force. *Enhancing the Nation's Conventional Bomber Force: The Bomber Roadmap*. 1992.

Dorr, Robert F. and Lindsay Peacock. *Boeing's Cold War Warrior: B-52 Stratofortress*. London: Osprey Aerospace, 1995.

Futrell, Robert F. *Ideas, Concepts, Doctrine: Basic Thinking in the United States Air Force*, Volume 1: 1907-1960. Maxwell Air Force Base: Air University Press, 1989.

Geer, Mary Wells. *Boeing's Ed Wells*. Seattle: University of Washington Press, 1992.

"General Curtis E. LeMay." U.S. Air Force Biography. Viewed online 2 January 2004 at http://www.af.mil/bios/bio_6178.shtml.

"The Gulf War: Air Force Performance in Operation Desert Storm." Viewed online 16 April 2002 at http://www.pbs.org/wgbh/pages/frontline/gulf/appendix/whitepaper.html.

Guttman, Jon. "McDonnell XP-85 Goblin," *Aviation History* 12 (2) November 2001, viewed online 28 January 2003 at http://preview.thehistorynet.com/aviationhistory/articles/2001/11012_cover.htm.

Hallion, Richard P. "Before B-2: Part Two: The History of the Flying Wing Since 1945." *Air Power History* 41 (4) Winter 1994, pp. 40-51.

Harding, Stephen. "Consolidated B-32 Dominator." From "Flying Terminated Inventory," *Wings*, April 1993. Viewed online 9 December 2002 at http://home.att.net/~jbaugher2/b32.html.

Hobbs, Major Daniel E. *Adapting Strategic Aircraft Assets to a Changing World: Technology Insertion to Provide Flexibility*. Research Report No. AU-ARI-92-10. Maxwell Air Force Base: Air University Press, 1994.

Julian, Thomas A. "The Origins of Air Refueling in the United States Air Force." In *Technology and the Air Force: A Retrospective Assessment*, ed. Jacob Neufeld, George M. Watson, Jr., and David Chenoweth. Washington, D.C.: Air Force History and Museums Program, 1997.

Knaack, Marcelle Size. *Encyclopedia of U.S. Air Force Aircraft and Missile Systems, Volume II: Post-World War II Bombers, 1945-1973*. Washington, D.C.: Office of Air Force History, 1988.

Mansfield, Harold. *Vision: A Saga of the Sky* [2nd Edition]. New York: Madison Pub. Associates, 1986.

Miller, Roger G. "Freedom's Eagles: The Berlin Airlift, 1948-1949." *Air Power History* 45 (3) Fall 1998, pp. 4-39.

Moody, Walton S. *Building a Strategic Air Force*. Washington, D.C.: Air Force History and Museums Program, 1995.

Neufeld, Jacob, George M. Watson, Jr., and David Chenoweth. *Technology and the Air Force: A Retrospective Assessment*. Washington, D.C.: Air Force History and Museums Program, 1997.

"New Systems Played Key Role in Afghanistan, Air Force Official Says." *Aerospace Daily*, 28 Feb 2002.

Parisen, Richard B., John C. Armstrong, and Sidney C. Huntley. *Theoretical Evaluation of the Ducted-Fan Turbojet Engine.* NACA Technical Note No. 1745. Washington, D.C.: November 1948. Viewed online 15 January 15, 2004 at http://naca.larc.nasa.gov/reports/1948/naca-tn-1745/.

Pollard, Robert A. *Economic Security and the Origins of the Cold War, 1945-1950*. New York: Columbia University Press, 1985.

Prime, John Andrew. "Bomber has roots in aviation legend and myth." *Shreveport Times*, 14 April 2002. Viewed online 12 December 2002 at http://www.shreveporttimes.com/.

RAND. "50 Years of Service to the Nation." Viewed online 19 February 2003 at http://www.rand.org/history/.

Rolfsen, Bruce. "Still Going Strong." *Air Force Times*, 10 February 2003, p. 14. Viewed online 6 February 2003 at http://ebird.dtic.mil/Feb2003/s20030206152183.html.

Rothman, M. B. *Aerospace Weapon System Acquisition Milestones: A Data Base*. Santa Monica: RAND, 1987.

"Second B-52 Test Flown." In *Army Navy Journal: Gazette of the Regular and Volunteer Forces*, including excerpts from September 20 to November 8, 1952. Viewed online 5 February 2003, Armed Forces Journal International, at http://www.afji.com/ AFJI/history/ Mags/2002/july02/july_2.html.

Shaw, Frederick J. and Timothy Warnock. *The Cold War and Beyond: Chronology of the United States Air Force, 1947-1997*. Washington, D.C.: Air Force History and Museums Program, 1997.

Simpson, Cliff. *The Memoirs of Ernest C. Simpson, Aero Propulsion Pioneer.* Ed. by James St. Peter. Wright-Patterson Air Force Base: Aeronautical Systems Division and Air Force Wright Aeronautical Laboratories, 1987.

Sirak, Michael, and Christopher Stagg. "Fresh Interest Brews to Re-Engine B-52s." *Jane's Defence Weekly*, 30 April 2003. Viewed online 28 April 2003 at http://ebird.dtic.mil.

St. Peter, James. *The History of Aircraft Gas Turbine Engine Development in the United States…A Tradition of Excellence*. Atlanta, Georgia: International Gas Turbine Institute of the American Society of Mechanical Engineers, 1999.

Suit, William W. "Utilitarian War Horse: Modifying the B-52 for Conventional War." *Air Power History* 44 (4) Winter 1997, pp. 36-49.

Trest, Warren A. *Air Force Roles and Missions: A History*. Washington, D.C.: Air Force History and Museums Program, 1998.

United States Air Force. Biography: General Curtis E. LeMay. Viewed online at http://www.af.mil/news/biographies/lemay_ce.html.

United States Central Air Forces, Assessment and Analysis Division. "Operation Iraqi Freedom—By the Numbers," 30 April 2003.

United States General Accounting Office. *Operation Desert Storm: Limits on the Role and Performance of B-52 Bombers in Conventional Conflicts*. Summary Report GAO/NSIAD-93-138, May 1993.

_____. *Strategic Bombers: Adding Conventional Capabilities Will Be Complex, Time-Consuming, and Costly*. Report to the Chairman, Committee on Armed Services, House of Representatives,GAO/NSIAD-93-45, February 1993.

Wagner, Ray. *American Combat Planes*, 2nd Edition. New York: Doubleday & Company, Inc., 1968.

Wall, Robert. "Elevating Info War: USAF Electronic Attack Plans Remain Murky, but Industry Lines up to Bid." *Aviation Week and Space Technology*, 13 October 2003. Viewed online 20 October 2003 at http://ebird.afis.osd.mil.

Wolk, Herman S. "The Battle of the B-36." *Air Force Magazine*, July 1996. Viewed online at http://www.afa.org/magazine/july1996/0796battl.asp.

Young, James O. *Lighting the Flame: The Turbojet Revolution Comes to America*. Edwards Air Force Base, California: Air Force Flight Test Center History Office, 2002.

Unpublished Sources

Aeronautical Systems Center History Office Archive. Aircraft/Bomber: B-52. ** boxes.

Aeronautical Systems Center History Office Archive. B-52 Bomber Files. ** boxes.

Aeronautical Systems Center History Office Archive. Biographical Files: Donald L. Putt.

Aeronautical Systems Center History Office Archive. Biographical Files: J. Arthur Boykin.

Aeronautical Systems Center History Office Archive. Laboratories/Propulsion. ** boxes.

Aeronautical Systems Center History Office Archive. Organizations/Engineering Division. ** boxes.

Air Materiel Command. "XB-52 Presentation: Status-Growth-Production." Given to U.S. Air Force Headquarters on 10 November 1949. In Box 3203: B-52 Bomber Files, Box 3, ASC History Office Archive.

Air Materiel Command, Directorate of Procurement and Industrial Planning, Procurement Division, Aircraft Section, Bombardment Branch. Semiannual Reports: B-52 Program. 1 January – 1 July 1951, 1 July 1951 – 1 January 1952, and 1 January – 1 July 1952. On file at Air Force Materiel Command History Office Archive.

Air Materiel Command, Directorate of Procurement and Production, Procurement Division, Aircraft Branch. Semiannual Report, B-52 Program, 1 January – 1 July 1952. Air Force Materiel Command History Office Archive.

Air Materiel Command, Directorate of Research and Development. Semiannual Report, 1 July – 31 December 1949. Air Force Materiel Command History Office Archive

Air Materiel Command, Engineering Division, Aircraft and Guided Missile Section. Semiannual Report, 1 January – 30 June 1950. Air Force Materiel Command History Office Archive

Air Materiel Command, Engineering Division, Aircraft and Guided Missile Section. Semiannual Report, 1 July – 31 December 1950. Aeronautical Systems Center History Office Archive

Bagwell, Margaret C. *The XB-52 Airplane*. 2 volumes. Wright-Patterson Air Force Base: Historical Office, AMC, 1949. Volume I: Text. Volume II: 139 supporting documents. In Box 3225: AFMC-AFLC Study No. 22, ASC History Office Archive.

Boeing Aircraft Company. *Development of the B-52 Airplane*. Boeing Document D-13009. 15 March 1952. In Box 3201: B-52 Bomber Files, Box 1, ASC History Office Archive.

Boykin, J. Arthur. Biographical File. On file at ASC History Office.

_____. Presentation: "Trends and Objectives for Bombardment Aircraft Development," 8 August 1949. In Box 3054: Aircraft/Bomber, Box 1: Development, ASC History Office Archive.

_____. "Reconnaissance Aircraft Characteristics and Limitations." Presentation to Reconnaissance Committee, 28 September 1950. In Box 3055: Aircraft/Bomber, Box 2, ASC History Office Archive.

Carroll, Major General Franklin O. Carroll, Director of Research and Development. Letter to Deputy Chief of Staff for Materiel. Subject: Study of Proposed Specification for a Heavy Bombardment Aircraft, 23 September 1948. In Box 3057: Aircraft/Bomber, Box 4, Aeronautical Systems Center History Office Archive.

"Contract Changes to Acceptance Schedules, B-52 History," November 1962, p. 3. In Box 3212: B-52 History Supplement, Box 12, ASC History Office Archive

Engineering Division, Air Materiel Command. Presentation: "XB-52 and XB-55," 17 December 1948. In Box 3214: B-52 Bomber Files, Box 14, ASC History Office Archive.

_____. Monthly Project Reports: May 1949, July 1949, January 1950, April 1950, and October 1950. In Box 2018: Organizations/ Engineering Division, Box 6 of 11, ASC History Office Archive.

_____. *Post-War Review,* 13 May 1947, p. 1. In Box 2022: Organizations/Engineering Division, Box 9 of 11, in ASC History Office Archive.

Engineering Division, Air Technical Service Command. *Postwar Research and Development Program of the Army Air Forces, Air Technical Service Command, Project B-7* (Revised)," 25 June 1945. In Box 2022: Organizations/Engineering Division, Box 9 of 11, ASC History Office Archive.

_____. *Scope and Procedure Plans, Project B-7: Post-War Research and Development Program, Five Year Period, F.Y. 1946 to F.Y. 1950 Inclusive*, 15 August 1944. In Box 2022: Organizations/Engineering Division, Box 9 of 11, ASC History Office Archive.

Fairchild Corporation. Presentation: "Study of Proposed Specification for a Heavy Bomber Aircraft," 23 September 1948. In Box 3057: Aircraft/Bomber, Box 4, ASC History Office Archive.

Greene, Warren E. *The Development of the B-52 Aircraft, 1945-1953*. 2 volumes. Wright-Patterson Air Force Base: Historical Branch, Wright Air Development Center, Air Research and Development Command, May 1956. Volume I: Text. Volume II: 90 supporting documents. In Box 3208: B-52 Bomber Files, Box 8, ASC History Office Archive.

History of the B-52 Supplement. Five Binders. (1) Unnumbered documents dated October 1948 – January 1950. In Box 3203: B-52 Bomber Files, Box 3, ASC History Office Archive. (2) Unnumbered documents dated January – December 1950. In Box 3209: B-52 Bomber Files, Box 9, ASC History Office Archive. (3) Unnumbered documents dated January 1951 – December 1951, and (4) Unnumbered documents dated January 1952 – June 1953. In Box 3210: B-52 Case History, Box 10. (5) Unnumbered documents dated January 1952 – June 1953. In Box 3211: B-52 History Supplement, Box 11. Some of the documents in (5) are copies of those in (4).

Jansen, P.N. *Preliminary Production Study, B-52*, 1 February 1951. In Box 3211: B-52 History Supplement, Box 11, ASC History Office Archive.

Ljunggren, E.N. (Lieutenant Colonel). Presentation to Committee on Aeronautics of the Research and Development Board, 22 April 1950. In Box 3212: B-52 History Supplement, Box 12, ASC History Office Archive.

Mandeles, Mark David. *The Air Force's Management of R&D: Redundancy in the B-52 and B-70 Development Programs*. Unpublished Dissertation, Indiana University, 1985.

Minutes of AMC Conference. 5 April 1949, 12 July 1949, 1 September 1949, 1 November 1949, and 6 December 1949. On file at AFMC History Office Archive.

Office of the Inspector General, Headquarters, Air Materiel Command. B-52 Weapon System Survey, 6-18 February 1955. Volume 1 of 2. 9 March 1955. In Box 3205: B-52 Bomber Files, Box 5, ASC History Office Archive.

Organizational Charts. Air Materiel Command, Air Technical Service Command, Aircraft Projects Section, Engineering Division, and Wright Air Development Center. On file at ASC History Office Archive.

"Outline of Presentation for Mr. Zuckert, The XB-52 is Used as an Example of One Project," n.d. In Box 3055: Aircraft/Bomber Box 2: Development, ASC History Office Archive.

Patchin, Kenneth L. and James N. Eastman. *The B-52 Stratofortress*. *Volume I: B-52 Management*. Tinker Air Force Base: Oklahoma City Air Materiel Area, 1961. In Box 3202: B-52 Bomber Files, Box 2, ASC History Office Archive.

Putt, Donald L. Biographical File. On file at ASC History Office.

Self, Mary R. *History of the Development and Production of USAF Heavy Bombardment Aircraft, 1917-1949*. AFMC/AFLC Study No. 195. Wright-Patterson Air Force Base: Historical Office, December 1950. In Box 3235: AFMC-AFLC Study No. 22, ASC History Office Archive.

"Summary & Comparison—Performance Data, Heavy Bombardment." In Heavy Bomber General file, Box 3057: Aircraft/Bomber Box 4, ASC History Office Archive.

Summary Minutes of the First Meeting of the USAF Aircraft and Weapons Board, 19, 20, 21, 22 August 1947. Inclosure 7. In Box 2030, ASC History Office Archive.

Summary Minutes of the Second Meeting of the USAF Aircraft and Weapons Board, 27, 28, 29, 30 January 1948, Inclosure 4. In Box 2030, ASC History Office Archive.

Technical Accomplishments of the Power Plant Laboratory, Fiscal Years 1946-1951, 3 September 1951. In Box 4287: Laboratories/Propulsion, Box 4 of 19, ASC History Office Archive.

Thurlow, Ron. "Notable Events in BUFF History," 10 October 1994. Chronology on file at ASC History Office.

Untitled Presentation, 19 February 1949. In Box 3055: Aircraft/Bomber, Box 2, Development, ASC History Office Archive.

Warden, H. E. (Lieutenant Colonel). Presentation: "B-47 Refueling Study." Given Headquarters United States Air Force on 5-6 January 1950. In Box 3198: Aircraft/B-47 Box 2, ASC History Office Archive.

_____. Presentation: "Light, Medium, Heavy Bombardment Objective." Given to Air Command and Staff School, Maxwell Air Force Base, Montgomery, Alabama, on 28 February 1949. In Box 3054: Aircraft/Bomber Box 1, Development, ASC History Office Archive.

Wright Air Development Division, Historical Branch. "Resume of WSPO Evolution, 1945-1960." 29 December 1959. On file at ASC History Office Archive.

XRB-52/B-52A Stratofortress, Reconnaissance and Side-by-Side Cockpit Mockup Inspection Report, December 1951, in Box 3211: B-52 History Supplement, Box 11, ASC History Office Archive.

Video Recordings

American Institute of Aeronautics and Astronautics. *Launching the B-52: Research and Design*, Part 1, 17 May 1982. Video Recording. On file at ASC History Office.

Gathering of Eagles: Research, Development, Test and Evaluation, Pete Warden and John Capellupo, June 1996. Video Recording. On file at ASC History Office.

Withington, Bob. Presentation given at MIT, n.d. Video Recording. On file at ASC History Office.

Interviews

Brown, Squire. Personal Communication with Lori S. Tagg, March 2003.

Boykin, J. Arthur. Telephone Interview with Lori S. Tagg, 15 January 2003. Notes on file at ASC History Office.

Koranda, Don. Interview by CNN, n.d. Viewed online 13 January 2003 at http://www.cnn.com/CNN/Programs/presents/shows/war.birds/archives/koranda.html.

Leaf, Major General Daniel P. Interview by CNN, n.d. Viewed online 13 January 2003 at http://www.cnn.com/CNN/Programs/presents/shows/war.birds/archives/leaf.html.

Warden, Lieutenant Colonel Henry E (U.S. Air Force, Retired). Interview with Lori S. Tagg, 20 July 2002. Columbus, Mississippi. Tapes and transcript on file at ASC History Office.

_____. Interview with Hugh Ahman, April 1993. Columbus, Mississippi. Tapes and transcript available at Air Force Historical Research Agency, Maxwell Air Force Base.

_____. Telephone Interview with Lori S. Tagg, 11 February 2003.

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